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The December number of the OPHTHALMIC RECORD will contain among others an original contribution by Nieden, "Ankylostomiasis and its effect upon the Organ of Vision"; one by Charles W. Kollock, M. D., "A case of Strabismus in a pure blooded Negro"; one by H. Gifford, M. D., "On the use of Epithelial lip-flaps and Half skin flaps in Eye Surgery"; one by Alfred J. Horsey, M. D., "Case Simulating Tumor of the Brain in which there were present headache, vomiting and Optic Neuritis, with remarks."

There will also appear reviews of the most recent contributions to Ophthalmology published here and abroad, editorials by prominent Ophthalmologists, society reports and miscellaneous items of interest.

The RECORD particularly desires short, practical papers on any subject connected with Ophthalmology. These will be published at as early a date as possible. It is understood that, unless otherwise arranged, original articles when accepted are contributed to the RECORD exclusively. Illustrative cuts will be made at the expense of the journal and proofs for correction will be sent to authors when desired. Reprints with covers are furnished at cost. One hundred of these will be presented to authors *gratis* when a request for them is written on the original manuscript. The RECORD will be issued monthly and each number will contain about 54 pages of reading matter.

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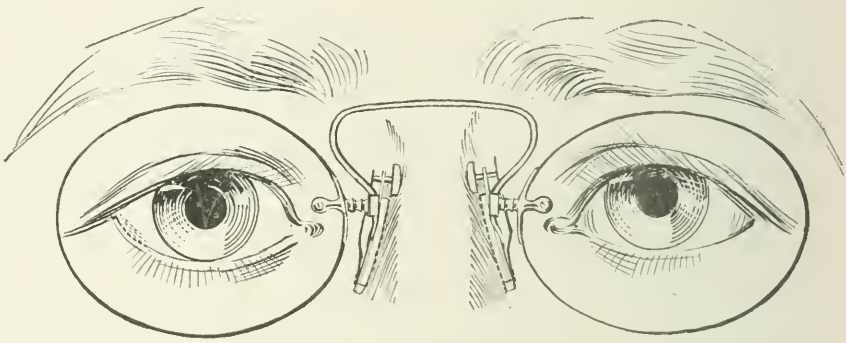

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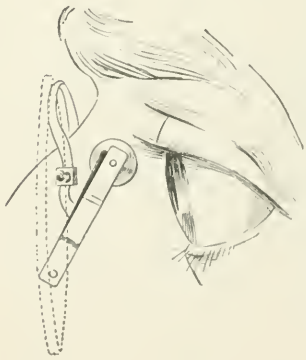

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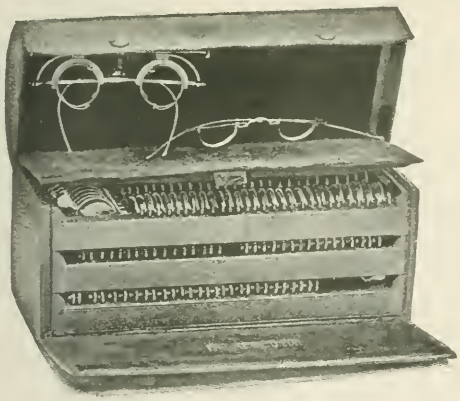

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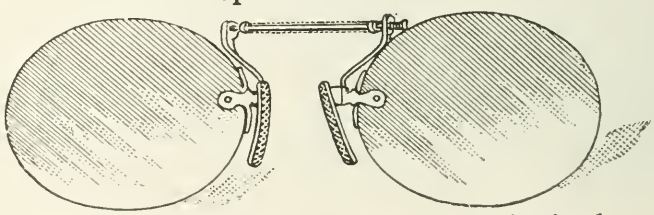

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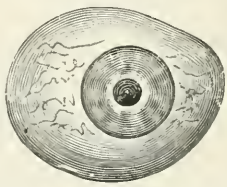

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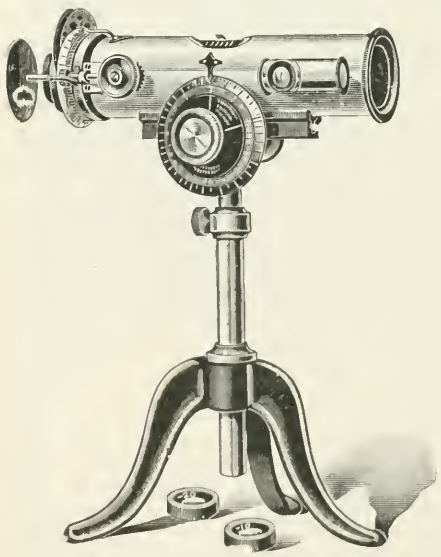

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THE
OPHTHALMIC RECORD

A Monthly Review of the Progress of Ophthalmology.

VOL. VI CHICAGO, NOVEMBER. 1897. No. 11, NEW SERIES.

ORIGINAL ARTICLES.

THE RELATION OF THE OBJECTIVE TO THE SUBJECTIVE METHODS FOR ASCERTAINING THE OCULAR REFRACTION.

By H. V. WÜRDEMANN, M. D.,

Milwaukee, Wis.,

Ophthalmic and Aural Surgeon to the Children's Hospital; to the Milwaukee County Hospital for the Chronic Insane; Director to the Wisconsin General Hospital, etc.

ILLUSTRATED.

The object of measuring the ocular refraction is not only to give the patient better vision and to cure asthenopia, but likewise to relieve the pain and discomfort which may be in other organs as well as in the eye. But a small minority of persons who have bought spectacles from jewelers or had them adjusted by so-called opticians or alleged oculists obtain full relief, although they may be partially suited by the approximate correction which in some instances may have been given. Many people tolerate a certain amount of discomfort caused by defective visual organs while in good health or when little close work is necessary for their vocation; others do not know the need of glasses. Deterioration of general health or increase of near work may develop ocular symptoms or render them more pronounced. The ophthalmologist is frequently consulted after the patient has run the gamut of the irresponsible trio above noted.

Although the full error of refraction is not always entirely corrected, it is necessary that this be known as a basis from which to estimate the lenses to be prescribed, and over or under correction given according to the exigencies of the case. It is my purpose in the fol-

lowing to show the proper sphere of the several better known objective and subjective methods for estimation of refractive errors. It is now accepted that no examination is complete without the use of all of these methods in addition to the subjective examination, as each one has a distinct field of application and value.

In the application of the objective methods several modifying factors are to be considered:

I. Those Belonging to the Observer.

(A) Physical:—(a) The accommodation of the operator should be relaxed, his eye fixed for distance and if ametropic the amount of his own error should be corrected. Some men have never learned to relax their accommodation sufficiently to allow of accurate observation by the ophthalmoscope. (b) The line of examination (visual line of the operator) must coincide as nearly as possible with the visual line of the patient, as the well-known irregularity of the cornea and lens gives different measurements when the line of examination is eccentric to the visual axis.

(B) Psychical:—(a) The most important of these is the personal equation of the observer. This may be defined to be the power accurately recording observation and varies according to his physical and mental condition. It is well known that when tired or worried the mind will not appreciate niceties of measurement in those procedures requiring close and accurate observation. This varies according to the observer. Some persons, no matter how capable in other ways, are unable to make accurate observations. (b) The experience of the operator is likewise a factor, as it is evident that accurate work cannot be expected of a tyro.

II. Those Depending upon the Patient.

(A) Physical:—(a) His accommodation should be perfectly relaxed for skiascopic or direct examination. (b) His pupil should be moderately or fully dilated. The relaxation of the sphincter afforded by the dark room and by his distance fixation is often sufficient, but in many cases a cycloplegic or mydriatic will be required. (c) The visual line of the patient must coincide as nearly as possible with that of the examiner.

(B) Psychical:—(a) The tractability of patients varies; some seem incapable of keeping the eye still; the mental hebetude of others is a hindrance, although this factor is not so important as in the subjective tests.

In the following I will presume that the lighting, instruments and position of the operator and patient are proper and deal mainly with the qualifications of the several methods as regards their accuracy and convenience. However, brief allusions will be made to the instruments and methods which I prefer.

Methods.

I. *Keratometry*:—For practical purposes the use of the ophthalmometer may be limited to the determination of the amount and axis of the corneal astigmatism.[8] It gives no hint as to the presence of myopia or hyperopia. Mydriatics are never required and are a hindrance to proper fixation by the patient. The instrument of Javal and Schiötz is the most applicable for clinical use; that of Helmholtz is more complicated and requires too much time. The ophthalmometer is to be used with the light from one-eighth of a hemisphere of clear sky, or the best artificial illumination, preferably the electric light; and so far as possible, the eye under examination is itself to be shielded from light. There must be steadiness of the instrument with the patient and surgeon in comfortable positions. The patient should fix the center of the objective in order that the measurements may be made in the visual axis, the principal meridian of the cornea (that which passes through the corneal axis) being ignored, and the examination made along the visual axis, as the ultimate object is not the measurement of the cornea but the fitting of a useful lens. Weiland[7] has demurred from this stand and to my mind goes to unnecessary trouble in the measurement of the angle alpha. It has been repeatedly shown that even so little as 5 degrees away from the visual axis on the corneal surface there may be a difference in curvature amounting to 1.00 or even 2.00 D.[1 5 9]

The corneal astigmatism does not usually coincide with the total astigmatic error. In emmetropia, hyperopia and myopia without astigmatism there is usually a corneal astigmatism of .25 to 1.00 D. (average .50 D.) *with* the rule which is neutralized by a corrective lenticular astigmatism which is *against* the rule. The fact that the lens is usually astigmatic is proven by those cases in which no corneal astigmatism is apparent at the visual axis and yet there is a total astigmatism of from .25 to 1.00 D. I have found that as a general rule this lenticular astigmatism averages .50 D. in adults and in children may be more, in old persons less, and that in but 20 per cent. of the cases it is the same. Thus as a general

rule the ophthalmometer may be considered to give .50 D. in excess of the astigmatism when *with* the rule and .50 D. less when *against*. Add the algebraic formula .50 D. to the astigmatism found by the ophthalmometer.[7]

Several years ago an eminent author came out with the statement that the astigmatism found by the ophthalmometer coincided with the total astigmatism and provoked quite a controversy. Refutations of his statements were numerous and it was shown that many cases of pure lenticular astigmatism occur of which the ophthalmometer gives no evidence. The axis of the corneal astigmatism in the visual line rarely differs from that of the total astigmatism. I find the variance in less than 5 per cent. of my cases. Although glasses are exceptionally prescribed (for instance, in oblique astigmatism) at a slightly different angle from that given by the ophthalmometer or from that elicited by the subjective test the change is usually one of judgment and necessary for binocular vision. I do not consider that more than one reading of the ophthalmometer is necessary, nor that it is advisable to strap the patient's head to the rest as has been advised by Lautenbach.[4] If variance be found in several readings such depends upon inaccurate observation.

The practical value of ophthalmometry, therefore, is mainly that of a method of examination that will make an important suggestion as to the presence, degree, or direction of astigmatism, which when followed up by other methods of measurement, may effect a greater saving of time.[8]

II. *Ophthalmoscopy*:—The determination of refraction by the *indirect method* with the ophthalmoscope is only approximate and inexact and its application inconvenient.

Examination by the *direct method* gives the total refraction. It enables us to immediately assign an approximately just share to the influence of ametropia in causing imperfect vision. The first ophthalmoscopic examination will in general give us the basis for a preliminary or approximate diagnosis of the refraction; the lens required to give the clear view of the fundus informing the observer of the hyperopia or myopia present, and the distinctness of the view that it gives indicating the presence, degree and regularity of astigmatism. All this is accomplished in perhaps a fraction of a minute.

The ability to measure by their refraction the relative position of different points seen by ophthalmoscopy, gives it an important value very imperfectly shared by skiascopy alone.

Of the ability of the ophthalmoscopic examination to reveal latent hyperopia, there must always be some doubt, for in a certain number of cases it fails to accomplish it. In this matter of rendering manifest the total hyperopia, it has not, in our own experience, shown any very pronounced superiority over the subjective method. Of the exactness of the determination made with it in my hands it will measure hyperopia or myopia to within 0.50 or recognize the presence of 0.50 D. of astigmatism and approximately the direction of its principal meridians.

The most serious hindrances, however, to constant accuracy of the ophthalmoscopic examination of ametropia are those dependent on the eye of the patient. If the patient's pupil be unduly small, the accuracy obtainable by this method is correspondingly diminished by the diminution of the circles of diffusion on the observer's retina. On the other hand, if the pupil dilate moderately, as it does in the majority of cases in a thoroughly darkened room, portions of the dioptric media will be exposed at the margin of the pupil that differ materially in their refractive power from the visual zone, and thus the refraction which may really be obtained by the refraction ophthalmoscope will differ essentially from the refraction of the visual zone which is sought.[8] The Morton or Loring refraction ophthalmoscopes or modifications of the latter seem to be the best forms.

III. *Skiascopy*:—Skiascopy is on the whole the most accurate and reliable objective method of measuring ametropia.[8] It measures the *total refraction* of the eye which may be modified by the accommodation or by glasses. It does not differ materially from ophthalmoscopy or the subjective test in detecting latent hyperopia; the subjective test being in intelligent patients perhaps the most accurate of the three methods. The difficulty in applying the test is greatly increased and the accuracy and certainty of its results diminished if the visual zone be very small, *i. e.* if that portion of the cornea further than 5 degrees from the visual axis be of different curvature than that of the central point. These eyes are the exception, and yet where the method is carefully used in irregular corneal curvature, in conical cornea, in partial lenticular or corneal opacity and other high grades of astigmatism, it is a full confirmatory test, as in nearly all eyes the result of careful skiascopic measurement will give the best obtainable vision. When used with the combination of lenses decided upon from the trial case it is a check upon other methods and upon itself.[2 6 8 10 13] The same general rules as regards the visual axis of the examiner and the patient are applicable as in ophthalmoscopy and

the same personal limitations apply. Examination is usually best conducted at 1 meter from the patient, and with the plane mirror, the source of illumination being near the surgeon's own eye, the appearance observed in all eyes being reduced to those of an eye having a myopia of 1 D. If a weak minus or plus glass be put before the eye, movements with or against the mirror are elicited. In astigmatism the band of light is to be developed and its movement neutralized The phenomena of the shadow test are presumed to be known and are fully described in numerous articles and books.

Although the application of the method may be carried out by the ordinary plane mirror, trial case and test lenses it has been found advantageous to have a small amount of apparatus, all of which is comparatively inexpensive. In order to obtain the satisfactory point

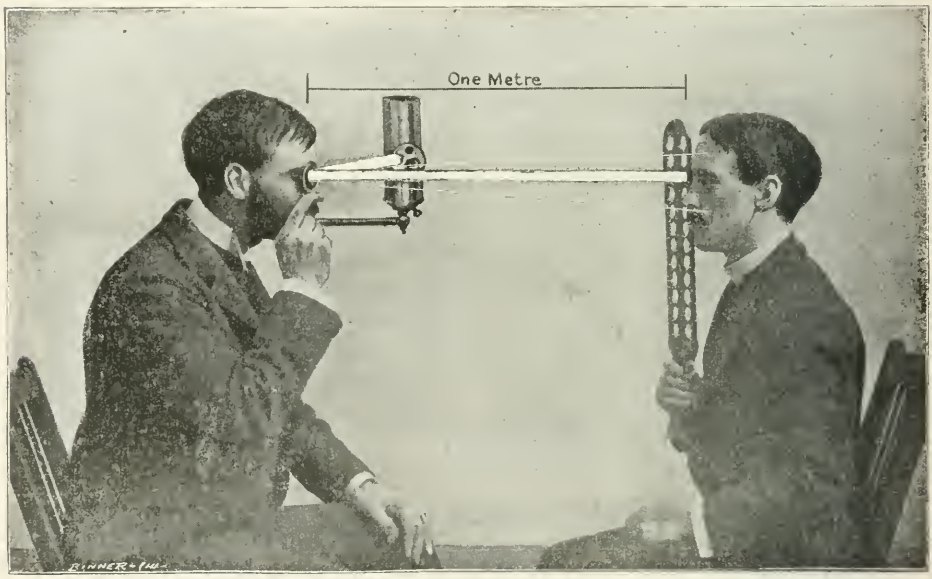

Fig. 1.—Skiascopy with the plane mirror, cover chimney and hand skiascope.

of light special cover chimneys for the Argand burner have be e devised, the best of which is that of Thorington.[6] Special plane mirrors have also been advocated by a large number of operators. Jackson[2] has a new mirror with sight hole made by removal of a portion of the silvering of the mirror and the backing flushed even with an additional piece of glass, having also an adjustable disk which serves the purpose of a cover and converts the reflecting surface into a

large or small mirror as desired. The axometer of Thorington and inclinometer of Prince have their special indications for determining the exact astigmatic axis.

The disadvantage of placing and replacing the lenses from the trial case has been obviated by a number of large and small instruments. The simplest of the disk forms being those of Burnett and of Würdemann[10]; a recent addition to the armamentarium, being a complex stationary instrument designed by Jennings.[3] I have however found that the simple hand skiascope (see Fig. 2) manipulated either by the patient at the direction of the operator (see Fig. 1) or held in one hand by the operator in front of the patient answers the purpose and is more applicable, on account of its simplicity. In addition to this I keep in the dark room several pair of reversable frames containing 1.00 D. and 2.00 D., 3.00 D. and 4.00 D., 1.00 D. and 2.00 D. upon which the lenses of the hand skiascope are superimposed for the higher degrees of ametropia. In practice it is often convenient to commence the skiascopic examination over the spherical lenses which have been found by ophthalmoscopy. As each meridian is corrected at a time, the spherical glasses alone are necessary for the test, although after the subjective examination is over the correction found is usually subjected to a revision by skiascopy, when of course the combination of spherical and cylindrical lenses which may be necessary for the case are placed in the trial frames upon the patient's face. It is now considered that with an eye otherwise normal except for its refractive error and being under the influence of a reliable cycloplegic, there is no more accurate objective method of obtaining its exact correction than skiascopy.

Skiascopy has the following advantages:

The character of the refraction is quickly diagnosed.

The exact refraction is obtained without questioning the patient.

Little time is required to make the test.

No expensive apparatus is necessarily required.

Its great value should never be underestimated in nystagmus, young children, amblyopia, aphakia, illiterates and the feeble minded.[8]

The aspirant should remember, however, that skiascopy is a difficult method to master and that although the theoretical basis is perfectly simple and the phenomena readily observed, nothing but a thorough understanding of the optical principles and long practice will render one an accurate skiascopist.

By any one of the objective methods in common use the eye may

be measured and glasses prescribed, but we should ultimately come down to that final test which is given by the patient himself after he has had the prescription filled. It were foolish to assert that any one method should be relied upon to the exclusion of others. All objective forms of examination are subservient to the test at the trial case and may be considered as essential preliminaries to the same. It is my routine practice in all cases (even simple presbyopia), to examine the patient by ophthalmoscopy, skiascopy and the ophthalmometer in order to ascertain the optical condition of the eye before proceeding to the subjective test.

Fig. 2.
Hand Skiascope

There are some points of interest, perhaps peculiar to myself, that I deem of considerable importance. In the order of examination for refraction cases, I first ascertain the visual acuity, then use the ophthalmometer, then try the shadow movement by the concave mirror, proceeding at once (if the patient be over forty) to the direct method and skiascopy with the plane mirror, after which the subjective and the muscular tests are made. If the person be under forty years of age and not strongly myopic or if not otherwise contra-indicated, a mydriatic is used, usually the gelatin disks of homatropin and cocain of Casey A. Wood. Atropin is never needed for any of the objective tests. I find it occasionally indicated for satisfactory examination by the subjective method in accommodative spasm, and in hyperopic cases where on account of imperfect relaxation of accommodation under homatropin there is considerable discrepancy between the results as found by the objective methods and the trial case. Atropin is usually instilled for refraction of children's eyes. I prefer the hand skiascope to the more complex rotary disk. My own model of the rotary disk has been laid on the shelf for several years, while the hand skiascope (see Fig. 2) is used several times daily.

In moderate or high myopia or hyperopia I often find it useful to put the sphericals as found by the refraction ophthalmoscope on the patient and then to make the finer measurements by superimposing the skiascope, adding thereto the strength of its lens in booking the value

of the meridional refraction. From the findings of these objective methods one may proceed at once to place the chosen lenses before the patient's eye. Thus the subjective test may be practically reduced to the trying of one or two higher or lower combinations and to the determination of heterophoria. The lenses thus found are then proven by brief skiascopic and direct examination in the dark room.

The objective methods of measuring ametropia are as follows:

1. By effecting a saving of time; and by this, and as confirmatory tests, securing accuracy.

2. They are applicable to cases and to uses for which the subjective method is entirely inapplicable and useless.

Thus the objective methods can be applied to determine refraction in the eyes of small children, in the mentally defective and in the lower animals. Also in the eyes of malingerers, conscripts, applicants for pensions, insurance, or society benefits, plaintiffs claiming damages for injury, or in general wherever the coöperation necessary for the subjective test is lacking, because of lack of intelligence, perversity or self-interest.

It should be borne in mind that all the methods of testing the eyes are but a means to an end and that no one method should be relied upon to the exclusion of others.

The array of modifying factors here brought forward regarding the objective methods are as nothing to that great obstacle encountered in all subjective examinations. This is the fact that we are here dealing with a person unskilled in observing niceties of difference and shades of value, whose statements are not to be depended upon, and where all the points as to personal equation apply with much greater force. How often it is that we find after many tests by the trial case that the patient will accept equally well a number of combinations; for instance $+.50 \bigcirc +1.50, 90°$, or $+.75 \bigcirc +1.00, 90°$, or $+1.25 \bigcirc +.75, 90°$. If we have made the objective tests we know within .25 or .50 D. what we had best take and place that combination immediately before him; with but few changes (usually only in the sphericals) the examination is completed. Thus by the preliminary use of the objective tests we eliminate in a great measure dependence upon the faltering judgment of the untrained patient and substitute therefor the skill of the expert. Many a weary hour of anxious application at the trial case is saved me and my associates by the objective methods; better work is done and patients are refracted in one-fourth the time necessary for conscientious work by the trial case alone.

There is no royal road to the acquirement of dexterity in the use of the objective tests; while easy to the expert, considerable practice is necessary before accurate work may be depended upon. As inactive minds and slow fingers are apt to be too conservative, thus it is that many have been too lazy to take upon themselves the needful training to properly apply the objective tests. It is a painful fact that many otherwise good ophthalmic surgeons depend entirely upon the trial case and do refraction work which in point of accuracy is but on a par with that of the average jeweler or "optician" who sells glasses.

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COMPLETE BLINDNESS DUE TO ACUTE POISONING FROM OVER USE OF ESSENCE OF JAMAICA GINGER, RECOVERY FOLLOWED BY TOXIC AMBLYOPIA OF THE ORDINARY CHRONIC FORM WITH EVENTUAL ATROPHY.

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ILLUSTRATED.

As this case presents several very interesting points as regards the fields and uncommon nature of the drug producing the poisoning, (which is the first case of this condition due to Jamaica Ginger reported) and as it has passed through both an acute and chronic form, I think it may help to throw some light or help to confirm some of our theories on this very interesting condition of toxic amblyopias.

The history of the case is briefly this:

J. R. age 32, sailor, mother and father both dead, does not know cause of death father supposed to have died from phthisis. Had diseases of childhood but never any serious disease denies absolutely any specific or venereal trouble. Never has been a steady drinker. From his occupation as a sailor would go several months without drinking any alcohol but would at times on reaching shore go on a spree for a couple of days, this he states to have occurred two or three times a year. He has been moderate in the use of tobacco, smoking a pipe and about a five cent package of tobacco a week. Eye sight always been good until Dec 22, '96 when he came ashore from a cruise and with a party of friends, being unable to procure whisky, became intoxicated on essence of Jamaica Ginger, the ordinary commercial kind sold in country stores. This was taken as whisky is with water. He remained intoxicated for two days, estimating in that time to have taken about a quart and a half of the Jamaica Ginger. The first day after he stopped he describes his feelings as being those similar to a bad alcohol debauch, headache, nausea, sick stomach, etc. On the evening of the next day, the fourth day from the first taking of the drug, while lighting the lamp in the cabin of the vessel, he noticed that everything appeared hazy and that his vision was failing, also some slight photophobia. By the next morning he could not see a lighted match held directly before him, but had peripheral vision sufficient for him to grope his way around that day. The next morning (fifth day) however his light perception had entirely disappeared both central and peripheral, and he was completely blind. This condition lasted seven days when the vision gradually began to return, first from the periphery of the field until finally he was able to read very large print with great difficulty (headings, etc.) The time required from complete blindness to this condition of recovery of his vision he estimates to be about four weeks. He remained in this condition about three weeks when he noticed his vision again be-

ginning to fail, this time very slowly until the present condition appears which is three months and a half from the first taking of the drug and he has not had any treatment.

The anterior aspect of the eyes are apparently normal (cornea and conjunctiva) pupils slightly dilated, but react normally both to light and accommodation. V. R. = Fingers at 1 meter. V. L. = $\frac{1}{100}$ excentric. Ophthalmoscopic examination. Media clear. The disc very pale, few capillary vessels present. The portion of the disc occupied by the papillo-macular bundle of fibres, being the lower and outer quadrant of the disc, is completely atrophied, being greenish white color. Fundus otherwise normal There is a well marked physiological cup and no lymph on the vessels showing the atrophy to be primary and not secondary to a previous papillitis. There is no evidence of any cerebral or spinal trouble, (locomotor ataxia, disseminated sclerosis or hysteria.)

I may state here that he describes one of his friends, that accompanied him on this spree, to have had his vision similarly affected but not to such a degree; he however, was treated and recovered. In questioning him more closely some three months after I first saw him he stated that since his vision had been affected he had heard of several other cases in which Jamaica Ginger was the cause of defective vision and that its use as an intoxicant is very common in places where alcohol in forms of whisky could not be obtained.

The case presents several interesting points.

I. The uncommon nature of the drug producing the loss of vision.

II. The suddenness of the attack of complete blindness.

III. The interesting point presented by the fields, which shows us most probably the pathological condition that takes place in the nerve in these cases.

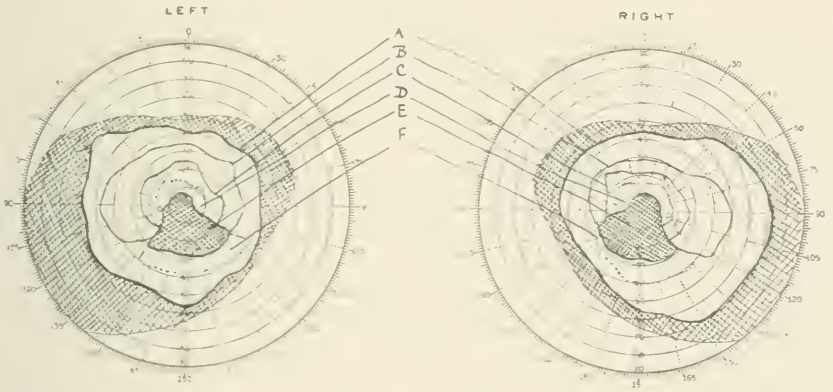
There is a question of difference between some writers on this subject as to whether alcohol which is adulterated with certain substances is more or less liable to produce toxic amblyopia than the pure spirits? But it is generally conceeded by all, I think, that the cheapest and worst kind of alcohol is more liable to produce this condition. I have been unable to procure a specimen of the Jamaica Ginger taken by the patient, he however describes it as the ordinary commercial kind, but publish the following letter from Prof. Remington of the Philadelphia College of Pharmacy to whom I wrote to ascertain the ingredients contained:

"What is known as Jamaica Ginger or more properly Essence of Jamaica Ginger made in a very simple manner by percolating the ground ginger root with alcohol, or alcohol containing water. The cheap trash found in country stores is often made with a portion of capsicum, in this way saving expense. You can see that a very little

capsicum would take the place in pungency of a large quantity of ginger. Of course sufficient ginger would have to be used to give a flavor to the decoction. Then again if it is made hot with cayenne pepper, a weaker alcohol can be used, and this would cheapen the product very much. Trusting I have been of service, etc. Joseph Remington."

From the suddenness of this attack of blindness, the perferred character of the condition following and history of a friend and several other cases being affected in the same way, I think it shows undoubtedly that the presence of foreign substances in the spirits is more liable to produce toxic conditions.

The fields are the most interesting part of the case as they show probably the pathological process that has and is taking place in the nerve.



DESCRIPTION OF FIELDS.

A. Form Field. B. Blue Field. C. Red Field. D Area Relation Scotoma for Color. E. Posterior Scotoma Complete blindness. C. Red Field. J. White seen dimly. Relative scotoma if color fields large enough.

The charts represent the last fields taken which is some six months from the time of first taking the drug; the character has not materially changed with the exception of a slight contraction in the form field, so I only show the most recent ones. The contraction of the form and color fields (which were taken in a good light) I take to be due to the general atrophy of the nerve. As I unfortunately did not see this case until some three months after the drug was administered, I cannot show the fields immediately following the acute blindness. But from the picture shown by the fields today I surmise, that on recovery from acute blindness, there was a central scotoma of the ordinary form,

occupying the area from the fixation spot to blind spot. This as shown by the chart has gradually enlarged until it has broken through the color fields. The area represented by letter F. shows that although white is seen, it is only dimly, in relative comparison to other portions of the field and this area would show a scotoma for colors if the red and blue fields were large enough; this clearly indicates that this portion of the nerve although not atrophied is decidedly affected and if the case terminates badly, as it probably will, the positive scotoma will finally break its way out to meet the periphery of the field.

As there has never been a post-mortem examination reported in an acute case of this character and as there is a primary atrophy of the nerve I take it that the following change has taken place in the nerve:

First, from the profound poisoning the patient was subjected to, we have an acute interstitial retrobulbar neuritis or effusion into the sheath of the nerve, affecting as alcohol always does, the papillo-macular bundle of fibres, and producing at first most probably a central scotoma negative in character (for color not form) this causing the blurring of vision on the first day.

As the interstitial neuritis or effusion into the sheath of the nerve increased, the pressure on the axis cylinders became greater, the scotoma gradually changed from negative to positive in character and finally becoming larger and larger until it spread over the entire field causing complete blindness. After the seven days of complete blindness as the neuritis or effusion subsided and the pressure relieved, the vision gradually returned with the exception of the papillo-macular bundle which owing to its depth in the nerve was more seriously affected by the pressure. Now as the vision again began to fail after three weeks of comparative recovery, I think this to be due to a consecutive atrophy following the pressure which was exerted upon the axis cylinders by the neuritis which appears to be clearly demonstrated by the interesting fields, showing the breaking through of the scotoma, which indicates that the atrophy is not only confined to the papillo-macular bundle but has extended to the adjacent fibres; and will eventually react the limit of the field. The case has been under my observation for the past three months and received all the forms of treatment for toxic cases, the change has been slight but if any for the worse.

A CASE OF TRAUMATIC BLINDNESS, WITH PARTIAL RECOVERY OF VISION AFTER FIFTEEN MONTHS.

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New York.

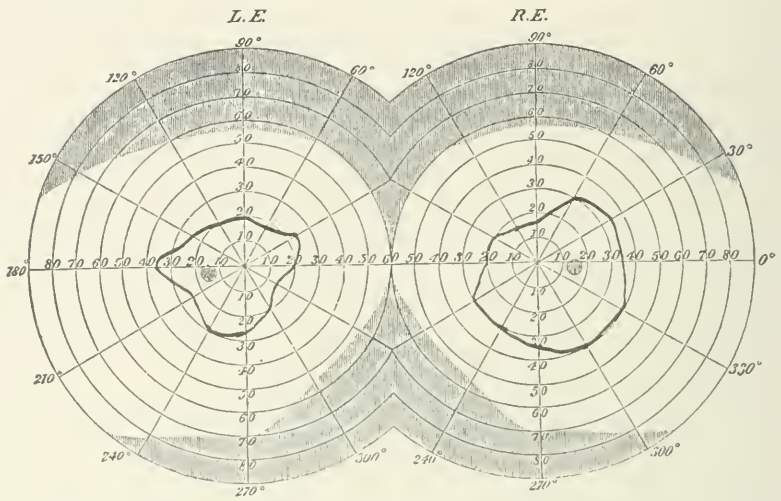
ILLUSTRATED.

On August 8, 1890, J. S., aged 30, in coming out of a low doorway, struck his head with considerable force against the top of the doorway. At the time he was with a driving party, and during the return to his hotel the jar of the wagon caused him intense pain. Before the hotel was reached he was somewhat delirious, and was supported in the wagon by his friends.

An examination of the injury showed an abrasion over the vertex, a little to the right of the median line, with slight swelling of the surrounding tissue. During the following night the physician in charge succeeded in restoring him to partial consciousness, but within a few hours stupor, alternating with delirium, set in, lasting five days. The hotel was situated near the railroad track, and the passage of the trains caused violent convulsions, beginning when the train was in the distance, and increasing in severity as it passed. So sensitive was his brain to the irritation of sound vibration, that each convulsion began before his attendants could hear the sound of the approaching train. Having continued violent about three weeks, the convulsions diminished in intensity and frequency and finally ceased about October 7th. Within five days after the accident he recovered consciousness and his mind, in the intervals between convulsions, was comparatively clear, except that memory of the distant past seemed defective, and the effort to think was painful.

One week from the accident, after a convulsion he noticed objects in the room were indistinct, and each day thereafter his vision decreased. Within one week more for an hour after each convulsion, his vision would leave him, recovering partially in the intervals. On August 22d, an especially severe and prolonged convulsion was caused by the passage of two trains in quick succession, and all that evening vision remained very indistinct. The next morning he had merely perception of light, and within two days total blindness set in, which lasted fifteen months. In September he was examined, with a view to operative interference, but doubt as to the locality of the lesion decided against the operation. It was found that the left arm and leg were partially paralyzed, sensation being also impaired and the reflexes abolished on the same side. By the 15th of October he had sufficiently recovered from the weakness and prostration following the traumatic meningitis, to be removed from the hotel in the Catskills to his home in Orange, New Jersey. There his general health continued to improve, and the impairment of motion and sensation passed off gradually, until he was able, within a few months, to do anything that was possible without vision. Once, during the next year, an attack of stupor and convulsions occurred, of two hours duration, brought

on possibly by business anxiety and worry. On November 5, 1891, he noticed a



faint light, and within a week objects were visible. In December he could see comparatively well with the left eye. The right eye remained blind till the following spring, when it partially recovered sight, but not to the extent of the other eye. On November 12, 1892, he became unconscious for an hour after which his sight was dim for an hour and a half longer, but since that time he has had no trouble of the kind to my knowledge.

He was seen by me in July, 1893, when his vision was R. E. $\frac{12}{200}$, L. E. $\frac{20}{70}$, unimproved by lenses. The ophthalmoscope showed nothing distinctly abnormal in either eye. There was no disturbance of the ocular muscles at that time. Unfortunately, I failed to secure a satisfactory test of the field of vision, and I understand no tests, either of the field of vision or of the ocular muscles, were made within a short time of the accident or during his period of blindness. When I saw him, nearly three years had elapsed since the accident, and in that time some oculo-motor paralysis might have disappeared, or even degenerative changes in the retina made the field of vision less conclusive than if taken at an earlier date.

I have given this clinical history in detail because it seems to me to throw some light upon cerebral localization. The history shows hemiplegia, hemianæsthesia, and abolition of the reflexes, all of the left side, with total blindness, the latter apparently being developed in the course of a traumatic meningitis. I think it probable that there was bilateral homonymous hemianopsia, due directly to the traumatism, and although no charts of the field of vision taken shortly after the accident are at hand for demonstration, the little information of the present field of vision in my possession tends to show it to be markedly defective in both eyes. The pressure upon both cunei of a men-

ingeal exudate may well have caused the defective sight of an hemianopsia to become total blindness. The partial recovery of vision is in my estimation to be explained by the gradual absorption of the exudate, while the visual portion of the primary lesion has unfortunately been more permanent. The location of this primary lesion has been a matter of grave doubt, and all I can do is to suggest that it possibly was situated in the visual tract, near the right internal capsule. This is the only situation where hemiplegia and hemianæsthesia of the opposite side are combined with bilateral homonymous hemianopsia, the left internal capsule being out of the question from the crossed paralysis of motion and sensation referred to the left side. A lesion within the occipital lobe, or in the cortex, would not be accompanied by either hemiplegia or hemianæsthesia A lesion in the optic thalamus might have hemianæsthesia with hemianopsia, but not hemiplegia also. If the optic tract were affected near the crus cerebri, we might get hemiplegia and hemianopsia of the one side and oculo-motor paralysis of the other; but in our case we have hemianæsthesia and hemiplegia of the opposite side and no evidence of oculo-motor paralysis. Any lesion nearer the orbit in the optic chiasm would give unilateral or bilateral hemianopsia, but of course no hemiplegia or hemianæsthesia. The hemiplegia and hemianæsthesia apparently were pressure complications of a lesion confined to the visual tract, since they passed off within a few months, leaving as the permanent result merely the visual defect; and for that reason I do not consider a cortical location in the motor area for the primary lesion at all probable, for motor disturbance caused by traumatism is not usually transitory unless relieved by operation. If I am right in my location of the primary lesion, it was beyond the reach of direct operative interference; but if I am also right in my idea of the damage done to the visual centres by the inflammatory exudate, an attempt to relieve pressure and drain seems to me to belong to the surgery of the future if not of the present. There is very little shock or danger in a small trephine hole, which ought to heal with healthy granulation tissue within a week under proper aseptic conditions. I have had depressed fracture cases up and about in two or three days and the hole filled in under the first dressing, as undoubtedly have most of my professional brethren with surgical experience. I do not say I would have done as follows if I had seen the case at the time, but it seems to me that an immediate exploration of the motor area near the site of the external wound would have been good surgery to settle all doubt as to the state of affairs beneath

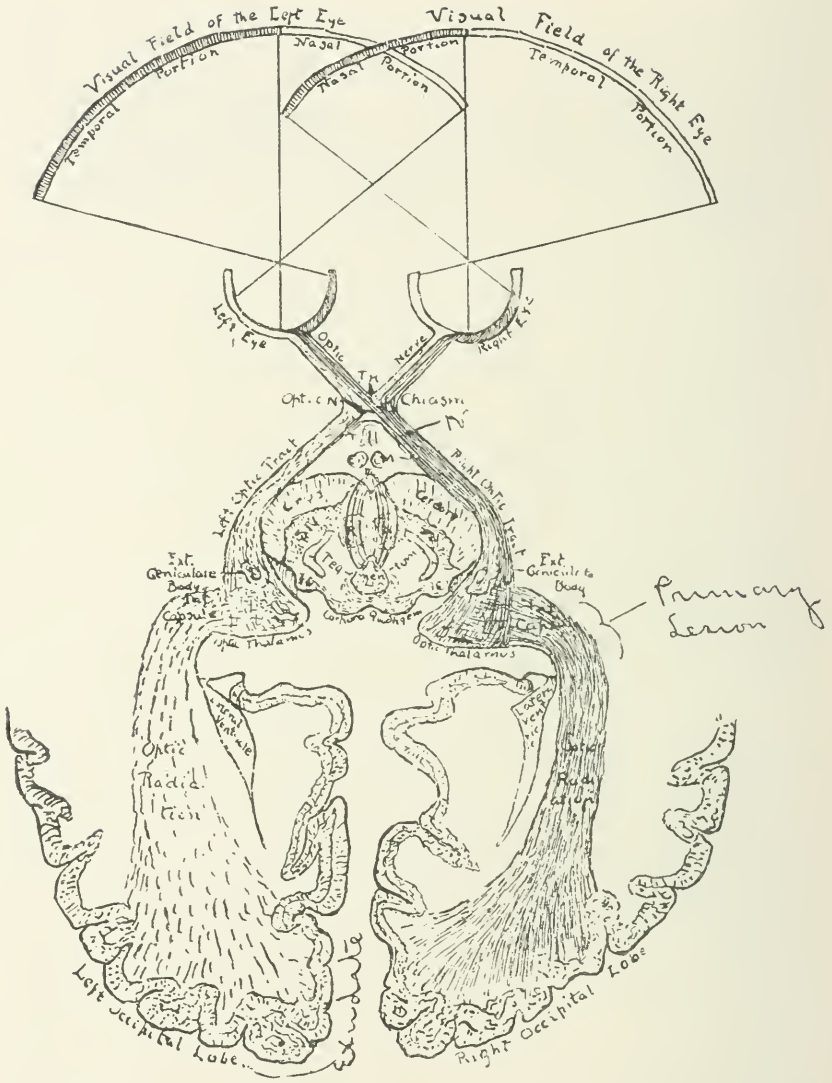


CHART OF OPTIC AND VISUAL TRACTS.

T. Unilateral hemianopsia.
H. Bilateral heteronymous hemianopsia.
N. Bilateral homonymous hemianopsia.

the skull cap. Perhaps nothing more than slight depression of some

spicule of bone might be found. If so, might not one possible cause of the meningitis be removed, and so the patient spared those disastrous convulsions? Secondly, I believe some day we shall make trephine openings in the post-auricular region for drainage of occipital pressure from hemorrhage or exudate, as in this case I have reported

Since writing the above I have had an opportunity to make another examination of the eyes of J. S,, with interesting results. His vision to day is: R. E. $\frac{20}{30}$, L. E. $\frac{20}{15}$, and by the ophthalmoscope the macula and optic disc seem entirely normal in both eyes. I give the field of vision, which is apparently more contracted in the left than in the right eye. He is in fairly good health, and with the exception of some headaches he does not find much trouble on using his eyes. His central vision is sharp and distinct for near and distant tests. There never have been any symptoms of alexia or aphasia.

THE AETIOLOGY OF DACRYOCYSTITIS.

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The following notes upon some of the factors in the causation of lachrymal suppuration are offered as a contribution to our knowledge of the bacteriology of this important subject.

Putting on one side those cases which can be definitely traced to an extension of the pyogenic processes from carious or necrosed bone in the immediate neighbourhood of the sac, and confining our attention to such as have their inception in the mucous membrane lining the interior of the sac, we recognise clinically three forms, viz:

(1) Mucocele.
(2) Acute Dacryocystitis.
(3) Chronic Dacryocystitis.

Whilst often merging the one into the other, the clinical picture of a typical case is sufficiently characteristic in each of the three groups; and it may not be out of place to briefly indicate their chief features.

Mucocele. This condition often gives rise to no discomfort, or at most the patient complains of watering of the eye or running over of the tears. On examination the lachrymal sac is found to be filled and distended with a clear or somewhat opalescent, viscid or gelatinous

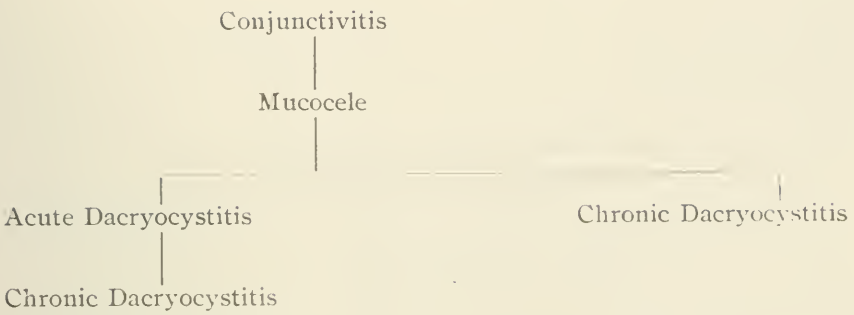
mucus, the distension giving rise to a small spherical swelling under the skin at the inner canthus, which imparts an elastic sensation to the finger. Firm pressure over the tumor results in the forcing of the contained mucus through the nasal duct, or its regurgitation through the canaliculi. Conjunctivitis is absent, although a previous history of "inflammation of the eye" of a muco-purulent type can generally be obtained.

Acute Purulent Dacryocystitis. Occurs as a rule in a sac already occupied by a mucocele. In this connection Nettleship remarks "A mucocele is always very apt to inflame and suppurate, the result being a lachrymal abscess. Most cases of lachrymal abscess indeed have been preceded by mucocele."

The formation of pus is usually ushered in by well marked constitutional symptoms, a rise of temperature of two or three degrees, sometimes accompanied by rigors, constipation, furred tongue, etc. Locally there is more or less extensive oedema of the root of the nose, eyelids, and upper part of the cheek, the skin surface being of a dusky red color. The tissues over the sac are brawny and infiltrated and the general appearance is suggestive of facial erysipelas. Pain is present in the vicinity of the sac, and is increased on pressure. In some few cases resolution takes place but the majority go on to suppuration. In the latter case the skin over the lower part of the sac may become thinned and give way allowing the pus to escape, and later this outlet occasionally causes a troublesome fistula. Marked conjunctival injection, together with a profuse serous discharge is almost invariably associated with this condition.

Sub-acute or Chronic Dacryocystitis. A commoner form of sac trouble than the acute. It not only occurs as a sequela of acute purulent dacryocystitis but frequently follows directly upon a mucocele, without the intervention of the acute stage. The chief symptom is epiphora; there is often no visible distension of the sac, and certainly no pain, but occasionally slight tenderness on pressure over the sac, a proceeding which results in the escape of a thin purulent or muco-purulent fluid from the canaliculi. A chronic conjunctivitis is an almost invariable concomitant.

The sequence of events is, firstly, some form of conjunctivitis on the subsidence of which a mucocele is noticed; upon this follows either a chronic dacryocystitis, or an acute dacryocystitis which in turn gives place to the chronic form, and may be graphically thus:



Turning now to the bacteriological aspect of the disease Morax has recorded the fairly constant presence of a slender bacillus in the gelatinous material contained in the sac in cases of mucocele. This bacillus, which was decolorised by Gram's method, was cultivated with difficulty and was evidently considered by the author as identical with the bacillus described by Weeks as the cause of acute muco-purulent conjunctivitis. Mazet mentions the presence of staphylococci and other organisms in subacute lachrymal inflammation.

Parinaud and Morax have described one form of acute conjunctivitis from which the *streptococcus pyogenes* has been isolated, and which is usually accompanied by an acute purulent inflammation of the lachrymal sac, and from the latter situation the same organism has been obtained. The opinion is expressed by these authors that the streptococcus may be considered as specific in such cases. Widmark has confirmed these observations, and more recently Mazet has found the same organism in what he terms "empyema of the sac," often however associated with another pyogenic organism viz. *bacillus coli communis*.

A summary of my observations on a series 26 "sac" cases is arranged in the accompanying table, but before discussing them a few words upon the technique adopted in collecting the pus, mucus, etc. are necessary.

Method. The edges of the lids are first cleansed as thoroughly as possible by means of a piece of sterile cotton-wool saturated with 1 in 2000 solution of hydrarg. perchlor. The conjunctival sac is next flushed out with sterile "normal saline solution," gentle pressure is made over the sac and the first few drops of pus expressed through the puncta are washed away by the stream of solution. The pressure over the sac is continued and the pus now exuding is removed on a sterile cotton-wool swab and planted on to slanted glycerine blood serum and also on to agar-agar. It might appear at first sight much

more simple to plant the material in neutral or faintly alkaline nutrient bouillon, but it has been my experience that if the streptococcus is present in pus etc. in association with other organisms such as staphylococci or sarcinae, these latter are liable to so out-number the streptococcus as to render its isolation a task of no mean proportion, and the difficulty is largely increased if bouillon is the medium used.

Material. The cases were derived chiefly from the ophthalmic out-patient department of Guy's Hospital; and those included in groups I and II are placed in the order in which they presented themselves for treatment. On the other hand a certain amount of discrimination was exercised in the selection of cases falling into group III, no case being included in which the condition had been in existence for a period longer than three months: for it was found that when suppuration had continued for long periods that it was difficult and indeed sometimes impossible to demonstrate the presence of the streptococcus—the commoner pyogenic organisms, the staphylococcus aureus and albus, having taken its place.

TABLE I MUCOCELE

Case	Initials	Sex	Age	Eye Affected	Duration of Disease	Organisms Isolated
1	A. H.	Male	5	R. E.	4 months	Staphylococcus albus—Weeks bacillus
				L. E.		Staphylococcus albus—Bacillus coli communis
2	E. B.	Male	38	R. E.	5 months	Staphylococcus albus & aureus—Weeks bacillus
				L. E.	6 months	Diplococcus epidermedis albus—Streptococcus brevis
3	Q. D.	Female	12	R. E.	3 months	Staphylococcus albus—Xerosis bacillus
4	K. H.	Female	28	R. E.	10 years	Staphylococcus albus—Xerosis bacillus
				L. E.		Proteus Vulgaris.
5	E. C.	Female	66	R. E.	2 months	Staphylococcus aureus—Bacillus coli communis
6	C. A.	Male	15	L. E.	8 months	Bacillus of Weeks—Bacillus megat

TABLE II ACUTE PURULENT DACRYOCYSTITIS

Case	Initials	Sex	Age	Eye Affected	Duration of Disease	Organisms Isolated
7	F. V.	Male	34	R. E.	3 days	Streptococcus pyogenes
8	L. C.	Female	23	R. E.	6 days	Streptococcus pyogenes—Staphylococcus albus
				L. E.	2 days	Streptococcus pyogenes
9	G. P.	Female	13	L. E.	6 days	Streptococcus pyogenes
10	F. H.	Female	15	L. E.	4 days	Streptococcus pyogenes
11	J. M.	Male	8	R. E.	5 days	Streptococcus pyogenes
12	H. H.	Male	23	L. E.	2 days	Streptococcus pyogenes
13	F. W.	Male	17	R. E.	8 days	Streptococcus pyogenes—Sarcina lutea
14	C. M.	Male	30	L. E.	3 days	Streptococcus pyogenes
15	H. W.	Female	5	R. E.	3 days	Streptococcus pyogenes—Diplococcus epidermedis albus
16	L. H.	Female	59	R. E.	7 days	Streptococcus pyogenes—Staphylococcus albus
				L. E.		

TABLE III CHRONIC DACRYOCYSTITIS

Case	Initials	Sex	Age	Eye Affected	Duration of Disease	Organisms Isolated
17	M. B.	Male	24	R. E.	3 months	Streptococcus pyogenes—Staphylococcus aureus
18	F. M.	Female	46	R. E.	10 days	Streptococcus pyogenes
				L. E.	3 days	Streptococcus pyogenes
19	M. L.	Female	36	R. E.	21 days	Diplococcus Pneumoniae (of Fränkel)
20	H. B.	Female	30	R. E.	13 days	Streptococcus pyogenes
				L. E.		Streptococcus pyogenes
21	G. A.	Male	21	R. E.	6 weeks	Staphylococcus aureus
22	H. P.	Female	12	R. E.	3 weeks	Staphylococcus aureus—Bacillus Xerosis
23	R. E. H.	Female	47	L. E.	14 days	Streptococcus pyogenes
24	D. G.	Male	30	R. E.	7 days	Streptococcus pyogenes
25	F. M.	Female	9	R. E.	15 days	Streptococcus pyogenes
26	S. S.	Female	44	L. E.	2 months	Staphylococcus aureus and albus

Taking the cases in the order of their clinical groups, it will be seen that in Table I. under the heading of Mucocele, no one organism has been found with any sufficient degree of constancy to warrant our attaching great importance to its presence in the viscid mucus. I have occasionally found in this situation a bacillus which in the first instance grows but sparingly upon such media as glycerine blood serum or serum agar, and is not stained by Gram's method. This I believe to be identical with Weeks bacillus of acute contagious conjunctivitis, but I am unable to confirm the statement of Morax that this bacillus is *constantly* present in such cases. The staphylococcus pyogenes aureus and albus together with the diplococcus epidermidis albus are frequently met with, so too is the bacillus xerosis—a common saprophyte of the inflamed conjunctival sac. The presence of a proteus has been noted; and once I have met with a streptococcus, and apropos of this organism a slight digression is necessary. Lingelsheim pointed out that there were at any rate two distinct varieties of the streptococcus, the one possessing marked pathogenic properties and growing in artificial media in long convoluted chains—the streptococcus longus; the other, non-pathogenic, and occurring as short chains, which he named the streptococcus brevis. More recently Washbourn and Goadby have confirmed these observations and have carefully worked out the biological and morphological differences between these two varieties—differences which may be conveniently summarised in parallel columns thus:

*Streptococcus longus.**	*Streptococcus brevis.*
1. Pathogenic when tested upon rabbits and mice (vide foot note.)	Non-pathogenic when tested upon rabbits and mice.

*The streptococcus pyogenes longus and the streptococcus erysipelatosus, whilst identical in their cultural characteristics are said to differ in their relative pathogenicity for mice: still for practical purposes they may be grouped together under the one heading.

2.	Grows in small flocculent masses in nutrient broth.	Grows as a uniform turbidity in nutrient broth.
3.	Cocci large, chains long and convulated when grown in broth.	Cocci small, chains short, when grown in broth.
4.	Produces a slight amount of acid in the course of its growth.	Produces a considerable amount of acid in the course of its growth.
5.	Does not clot milk when grown in this medium.	Clots milk.

The streptococcus isolated from the mucocele (case 4) undoubtedly belonged to the latter group, and was in point of fact identical with the streptococcus brevis which is now recognised as a common saprophyte of the buccal sulcus of the human mouth. Its want of virulence is shown by the following experiments.

Expt. 1. One loopful (0.5 mg.) of a 24 hour agar cultivation was emulsified with 0.5 cc. of sterile broth, and the mixture inoculated into the subcutaneous tissue of a mouse weighing 15 grammes. *Result.* No effect.

Expt. 2. 0.5 cc. of a 24 hour broth cultivation was injected into the posterior vein of the ear of a rabbit of 2000 grammes weight. *Result.* No effect.

It is worthy of note that of these six cases of mucocele four give a very definite history of a muco-purulent conjunctivitis of the affected eye, occurring within the preceding 6 months, and soon after the subsidence of the attack the lump was noticed. In the remaining cases, the condition followed an acute conjunctivitis accompanying an attack of measles in one patient: in the other the mucocele had existed since the "inflammation of the eyes" which complicated variola 10 years previously.

When however we come to consider Table II. (acute purulent dacryo-cystitis) the bacteriological results are somewhat different and certainly more definite. The streptococcus pyogenes longus is practically always present, and may be demonstrated in smear preparations made either from the pus, or, if the case presents itself at an earlier period when the oedema and infiltration are the prominent signs, the serum and blood from the affected area. Moreover the organism in question is invariably found in the serous exudation which is the marked feature of the accompanying conjunctivitis. This is an important point and one to which I shall again refer. The streptococcus longus usually occurs in the pus in a state of purity; occasionally however cul-

tivations show associated with it some few colonies of the xerosis bacillus, the diplococcus epidermidis, a sarcina, or some equally common inhabitant of the conjunctival sac.

The virulence of the streptococcus isolated from some of the cases was tested by inoculating mice with small quantities of a 24 hour old cultivation in nutrient broth, with the results shown in the following table:

INOCULATION EXPERIMENTS.

No of expt.	Animals	Weight in grammes	Source of streptococcus	Dose of culture	Method of inoculation	Result
3	Mouse	20	Case 8 Table 2	0.5 c.c.	Subcutaneously	Death in 5 days from streptococcic infection.
4	Mouse	19	" 11 "	0.5 c.c.	"	Death in 3 days from streptococcic infection.
5	Mouse	20	" 13 "	0.5 c.c	"	No effect
6	Mouse	18	" 15 "	0.5 c.c.	"	No effect
7	Rabbit	1760	" 15 "	0 5 c.c.	Intravenously	

The oft repeated observation that streptococci isolated from apparently precisely similar lesions in the human subject, possesses varying degrees of virulence when tested upon mice etc., is well shown in the above table.

Case 8 possesses an interest of its own in that the streptococcic conjunctivitis, which preceded the lachrymal trouble by some three days, was most probably contracted by the patient from the infant she was suckling—the baby being the subject of a membranous conjunctivitis from which the streptococcus longus was isolated, associated only with the xerosis bacillus.*

Cases 7, 10, 13 and 15 presented themselves during the first stage of the disease, when oedema and redness were the prominent features and before any considerable quantity of pus was present in the sac. In each of these cases slitting of the lower canaliculus was practised and in three of them (viz. 7, 10, 13) the fairly common sequel of this proceeding was observed, for after an interval of 2, 3 and 4 days respectively a severe and extensive cellulitis of a diffuse type made its appearance on the affected side of the face, spreading from the inner angle of the orbit upwards to the upper eyelid and on the forehead; outwards as far as the ear, and downwards to the angle of the jaw. This was accompanied by a rise of temperature (maximum varying from 99.8°

*In this case inoculation experiments were performed, as well as a long series of cultivations upon various media, in order that the identity of the xerosis bacillus might be placed beyond doubt, as in microscopical preparations it is next to impossible to differentiate it from B Diphtheria

F. to 102° F.) furred tongue, headache, and enlargement of the pre-auricular, sub-maxillary, and cervical glands. In case 15, recovery was uninterrupted.

In table III, it will be seen that the streptococcus longus was present in the muco-purulent discharge with a regularity deserving of more than passing notice, for out of 12 cases this organism was isolated from the muco-pus eight times. The diplococcus pneumoniae was found in one of the remaining four.*

The virulence of the streptococcus isolated from the cases in the third table was only tested once with the following result.

Expt. 8. 1 cc. of a 24 hour old broth cultivation from case 18 was inoculated into the subcutaneous tissue of a mouse of 20 grammes weight. *Result.* Death in four days from streptococcic infection.

The pneumococcus isolated from case 19 was tested in like manner and found to possess a certain amount of virulence.

Expt. 9. About 0.5 mg. of a 24 hour old "blood agar" culture was emulsified with 0.5 c.c. of sterile broth and injected subcutaneously into a mouse of 20 grammes. *Result.* Death in 5 days from pneumococcic septicaemia.

From these investigations it would therefore appear that the streptococcus pyogenes longus is almost invariably present in cases of acute and chronic inflammation of the lachrymal sac, usually in the former and often in the latter, in pure culture; and from our knowledge of the behaviour of this organism when it has obtained a footing in other mucous membranes we may fairly conclude that it holds a causal and merely a casual relationship to these processes.

With regard to the association of stricture of the nasal duct and blenorrhoea of the lachrymal sac, it is definitely stated or as clearly insinuated by practically all writers upon the subject, that acute and chronic inflammations of the sac are caused by stricture of the nasal duct, and the theory as to the causation of dacryocystitis which has been built up around this assertion may be briefly stated as follows:

1. Nasal catarrh.
2. The gradual extension of the inflammatory process from the nasal cavity to the lachrymal sac, viâ the nasal duct, producing during its progress an active oedema of the mucous membrane lining this

*This is the only occasion that I have been able to demonstrate the presence of this organism in the secretion from the many hundreds of cases of conjunctivitis—acute and chronic, whether accompanied by dacryocystitis or no—that I have examined bacteriologically.

latter, and thereby causing

3. Either a complete occlusion of the lumen of this tube or a localised stricture.
4. As a result of this obstruction to the outflow of tears and mucus, the lachrymal sac becomes filled and distended.
5. Pyogenic organisms gain admittance to the viscid mass by direct extension from the inflamed membrane of the duct, suppuration ensues and a
6. Lachrymal abscess becomes the outward and visible sign of an inward (and usually suppositious) stricture.

Whilst perfectly willing to admit that a stricture of the nasal duct when present, forms a very obvious predisposing cause of dacryocystitis, I am equally adverse to admit its presence in all or even many of these cases. I am in fact much more inclined to regard stricture of the nasal duct as a result of long continued suppuration of the sac, rather than as directly responsible for the causation of that suppuration.

I have already noted that the canaliculus was slit in cases 7, 10, 13 and 15. In each of them probes were used to ascertain the condition of the duct with regard to the question of patency, and in no instance was this found to be impaired.* The majority of the cases of chronic dacryocystitis were examined in a like manner, and of the cases included in table III. only twice was a stricture found to exist. These remarks do not however apply to numerous cases which were examined, but rejected for the purposes of this investigation on account of the length of time the suppuration has been going on. In such cases stricture was the rule and not the exception.

I have already referred to the fact that the streptococcus longus is invariably present in the serous exudation from the conjunctiva which accompanies cases of acute purulent dacryocystitis; it now only remains to add that this exudation is caused by an acute conjunctivitis which not only accompanies but precedes, by some days, suppuration in the sac. Case 8 affords an excellent and complete example of the course of events; and it would appear that the theory of the causation of acute dacryocystitis, handed down through generations of text-books, should be reversed and the steps of the process described as follows.

*It will be noted that the authorities agree in stating that the stricture is most usually situated at the junction of the sac with the nasal duct—a point where there normally exists a very definite constriction. Given a certain amount of inflammatory oedema of the lining mucosa of the sac, overhanging this constricted orifice and interfering with the passage of the probe, it is easy to imagine the presence of a stricture when such is not the case.

1. Invasion of the conjunctival sac by the streptococcus pyogenes longus, resulting in an attack of acute conjunctivitis.
2. Flushing of the conjunctival sac by lachrymal secretion and the washing of the streptococcus through the canaliculi into the lachrymal sac by the stream of tears.
3. Excessive secretion of mucus and exudation of leucocytes into the interior of the sac in the endeavour to remove the intruders.
4. Invasion of the mucous membrane lining the interior of the sac by the streptococcus; the appearance of the organism in the submucosa and finally in the cellular tissue surrounding the sac, and the consequent formation of pus in those situations to which it has gained access.

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*A PLEA FOR MORE MILD TREATMENT OF THE CONJUNCTIVA.

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In presenting a plea for more mild treatment of the conjunctiva, I desire to state that I advocate no drugs which have not been numbered among the multiplicity of remedies used in the treatment of affections of this membrane. The combination of drugs which I advocate have been used by me in the treatment of acute catarrhal conjunctivitis, chronic catarrhal conjunctivitis, follicular conjunctivitis,

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phlyctenular conjunctivitis and trachoma with its accompanying pannus. I shall not dwell upon the symptoms, course, etiology and complications of these diseases except as it may be necessary to illustrate therapy.

The remedies which have found most favor and stood the test of time, are the salts of zinc, copper sulphate and silver nitrate, together with some one of the antiseptics. Each of the remedies mentioned is an irritant astringent, and when used in such strength as to be potent for the chronic forms of inflammation, the reaction following the application is long continued and painful. Relapses, with exacerbation of the inflammation while under treatment, are the common experience of every oculist. This always necessitates discontinuance of the astringent remedy until the eye recuperates from the intolerance which it has manifested. While the eye is undergoing this revolt, the lesions are often re-established with such remarkable rapidity, that when the oculist again ventures an aggresive treatment, he may find the condition as far from cured as when the treatment was first begun.

The remedies above referred to cannot, with prudence, be placed in the hands of the patient to be used at home: thus really curative treatment can be applied only at the office, and therefore, much time valuable to the patient may be lost.

To illustrate the treatment which I wish to recommend, we will consider a patient with a severe attack of acute catarrhal conjunctivitis. The secretion has become muco-purulent, the lids are sealed in the morning, and there is the characteristic itching, photophobia and pain.

The conjunctival sac should be flushed with a solution composed of formalin, one part, to two or three thousand parts of boiled water.

The upper lids are then raised, or everted, and the fornix conjunctivae filled with a solution composed as follows: Boric acid gr. v, tannin gr lxxx, glycerin f. dr. iv, distilled water sufficient to make f. oz. i. The pain from the application of this solution is quite severe, but lasts only from one-half to one minute; the patient then complaining only of a "sandy sensation."

The conjunctival vessels become intensely injected, but this rapidly subsides, and in from twenty to thirty minutes the membrane is paler than before the instillation, the eye feeling cool and soothed. The patient may be provided with a vial of each solution and instructed to use the drops every two or three hours when awake. On the following morning there will be but little secretion, the lids not being

sealed and the eye a useful organ. Under this treatment complete recovery takes place in two or three days, providing the acute attack has not been grafted onto a chronic condition. Our authors acknowledge that under the treatment usually recommended this disease is but slightly shortened in its course, the principle aim of treatment being to prevent a chronic inflammation as a sequel. The merit of a therapy cannot be estimated when the experiment is confined to diseases which tend to spontaneous recovery; hence I will devote the balance of my paper to the consideration of trachoma.

Case 1.—About two years ago I was consulted by a poverty-stricken individual who was suffering with trachoma of several years standing. He was fifty years of age, used tobacco in quantity and manner peculiar to an inhabitant of the Missouri River bottoms. Vision and photophobia was such that it was with difficulty that he performed his farm work. The margins of the corneae were covered with pannus. The lids were lined with a thick coat of granulations and entropion was quite marked He asked for a prescription, stating that he was unable to pay for such treatment as he should have. I prescribed a solution containing boric acid gr. v, tannin gr. xxx, glycerin dr. ii and water sufficient to make f. oz i, and directed him to drop one or two drops into each eye four times daily stop the use of tobacco and when he could afford a proper fee, come to me for appropriate treatment. About four months later I met him on the street, and noticing that he wore his hat well back on his head, having no intolerence of light, I accosted him and learned that he had been having my prescription refilled, and had used it faithfully. The pannus was gone and the corneae were clear. I did not examine the lids.

Case 2.—Nov. 14, 1896, I was consulted by Amos W, age 34, farmer. History.—Left eye sore frequently since a boy at school. Eight months ago the left eye became much worse and the right eye also became affected. Had been treated most of the time since that date. Vision $\frac{20}{100}$ either eye. Diagnosis.—Trachoma; pannus either eye, worse on left; leucoma left, in pupillary area. I advised him to stop the use of tobacco; (which he did not do) and, as he lived ten miles distant, I provided him with a solution composed as follows: Boric acid gr. v, tannic acid gr. xii, glycerin f. dr. i, water q. s. f. dr. iv. Directions.—Drop two or three drops in each eye four times daily. He reported at my office two or three times each week, when I cleansed the conjunctival sac with the formalin solution and instilled a saturated solution of tannin in the equal parts of glycerin and water. All of the distressing symptoms subsided in three days, the pannus cleared away and two months from the date of beginning treatment I discharged the case, cured. He recently came to my office and I found the cure has remained permanent. The lids were thin and pliable, there being no cicatricial contraction which often occurs as a result of strong caustics more than as a result of the disease itself.

Case 3.—Dec. 15, 1896, I was consulted by J. R. R., age 50, had been running an emery wheel in the plow shops for sixteen years. In Feb. 1896, he was compelled to quit his work on account of trachoma. He was treated a

short time by his family physician who then advised him to go to the Illinois Charitable Eye and Ear Infirmary. He was treated at the infirmary four months with some benefit, then was sent home seemingly on account of the institution being over-crowded. His eyes became rapidly worse. He was then treated by a local oculist four months. Complaining that he received no benefit he was discharged with directions to bathe his eyes in hot water several times daily. He followed this advice for about one month, when he came to me with his eyes in the following condition: Vision either eye $\frac{20}{160}$, slight entropion of right lower lid, entropion of left lower lid quite pronounced. Puncti in very good position, epiphora marked, both eyes, with a profuse muco-purulent secretion. Slight pannus of right cornea, and quite intense of left cornea. The right upper and lower lids were lined with a thick layer of trachoma granules The left upper lid was much worse in this respect, having a cauliflower appearance. The case remained at my office during hours and was treated as heretofore indicated from three to six times daily. He was provided with a weaker solution of the depleting astringent which he used at home morning and evening. The purulent secretion had ceased by the second day At the end of the first week of treatment the vision of the right eye was $\frac{20}{15}$, vision of left eye $\frac{20}{70}$. At the end of the second week the tarsal cartilages were shining through, there being here and there a little tuft of granulations. I now allowed him to resume work in the dusty shop, treating him once daily. At the end of six weeks from the date of beginning treatment the granulations were gone there being only a slight roughening of the tarsal conjunctivae. The epiphora still continued. A marginal pannus which existed at the beginning of treatment had cleared away. I for some time saw the case but once or twice a week when I probed the nasal ducts, having the patient use a 1 to 3000 formalin solution at home. Though I was able to pass a No. 6 probe through the nasal ducts to the floor of the nostrils, the epiphora continued. A slight roughness of the tarsal conjunctivae persisted, with a tendency to increase after the astringent treatment was abandoned. Upon examination of the nostrils I found some hypertrophy of both inferior turbinated bones, a septal spur right and anterior, and hypertrophy along base of septum on left I removed the spur with a saw and reduced the other hypertrophied parts with the galvano-cautery. When the reaction from the operations subsided, the epiphora became promptly relieved. The slight exacerbation of the conjunctival trouble subsided promptly under a few treatments of the depleting astringent

I think in this case there not only existed an increased quantity of lachrymal secretion which was caused by reflex irritation from the rhinitis, but there was an actual mechanical obstruction at the lower orifice of the nasal duct due to turgesence of the mucous membrane in the inferior meatus.

I believe oculists do not pay sufficient attention to this condition. There are surely many cases in which mechanical obstruction exists that cannot be accounted for by either stricture or a flaccid condition of the membrane within the duct proper. It is reasonable to suppose that stenosis can occur at the lower orifice of the nasal duct from

causes analogous to those which cause primary closure of the lower orifice of the eustachian tube; yet, how many cases are treated long and patiently without giving attention to the nostril?

I have many other cases which I could report, but the ones which I have cited illustrate that a mild, depleting, astringent and antiseptic therapy for trachoma is worthy your consideration. There is no disease of the eye regarding which such a mass of literature has been produced as on trachoma. This is accounted for by the fact that no satisfactory treatment has been secured. Severe cases have been cured, but the treatment extended over many months and often years; and oft-times the result of the treatment is a cloudy cornea or a cicatricial lid which leaves the patient disfigured for life. Mild treatment has been used as a matter of necessity, as an adjunct to the trachoma forceps, a brush or caustics; but I wish to emphasize the fact that the mild treatment which I have indicated will speedily cure the severe cases, and is not in itself harmful to the eye.

Some of the advantages of the treatment may be summed up as follows: It is quickly curative, it promptly relieves the distressing symptoms. It can be repeated many times daily, thus obtaining a rapidly curative action. It is so mild that it does not interfere with the occupation of the patient, and may with safety be placed in his hands for use at home. Keratitis does not contra-indicate its use. There are no evil sequellae to the treatment, such as, agyrosis and cicatricial contraction. No relapses occur on account of an intolerance of the membrane, necessitating suspension of aggresive treatment.

A REPORT ON PATHOLOGY OF THE EYE.

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ILLUSTRATED.

Tension in Intraocular Tumours. The question of Tension in cases of Intraocular Tumour is one to which great importance is attached from a diagnostic point of view and one which is of great pathological interest. Indeed it is looked upon as being one of the most important signs of a tumour and one which is mentioned as being in certain cases almost the one thing needful to clinch the diagnosis.

We find it stated in many works on the eye that if there is a detachment of the retina with increased tension it is almost certain that he eye contains a tumour, while if there is a detachment with dimin-

ished tension this is almost sure to be simple, or at any rate one due to some cause other than the presence of a new growth.

Certain observations, however, led me to doubt the truth of this as one came across so many exceptions to the rule, and in order to determine this more accurately I examined one hundred cases, both after removal and as many as possible before removal also. The results I obtained were so striking that I read a paper on the subject before the Ophthalmological Society of the United Kingdom, and this was subsequently published in the Transactions of the Society for the year 1896

The cases fall conveniently into three groups :

1. Those containing a sarcoma of the choroid.

2. Those containing a sarcoma which either arises in or secondarily affects the ciliary body.

3. Those containing a glioma of the retina.

The following is briefly what was found :

Of the cases in the first group, which were 53 in number, the condition was :

Increased Tension in 36 or 67.92 %.
Normal Tension in 16 or 30.18 %.
(?) Diminished Tension in 1 or 1.88 %.

By this we see that it is far more common to get an increase of tension in these cases. In only one (and there was some doubt about it) was the tension noted as being below normal, and this was in a specimen which I had not the opportunity of examining before removal. In all these cases the angle of the anterior chamber was either much diminished or entirely closed.

Of the cases in which the tension was normal, the angle of the anterior chamber was open or at the most slightly constricted In the one which was doubtfully minus, the angle was open. A very different condition existed in the cases in which the ciliary body was involved.

Of the 28 thus affected there was :

Increased Tension in 10 or 35.71 %.
Normal Tension in 14 or 50.00 %.
Diminished Tension in 4 or 14.28 %.

Here the condition of the angle of the anterior chamber followed very closely the rule as above mentioned.

In the cases of glioma of the Retina, which were 19 in number, the condition found was :

Increased Tension in 7 or 36.84 %.
Normal Tension in 10 or 52.63 %.
Diminished Tension in 2 or 10.52 %.

Here again the condition of the angle followed closely the rule.

It it thus seen that in those cases in which the ciliary body is affected, the tension of the eye is on an altogether lower level than when the tension is far back, and also that the tension in the former is very similar to that found in glioma.

Since publishing this paper I have had the opportunity of examining 12 cases of sarcoma of the eyeball.

Of these 10 were of the melanotic variety and two were unpigmented. The ciliary body was only affected in one specimen, although it is by no means the case that sarcomata of this part of the uveal tract are as uncommon in proportion to those of the choroid as this would lead one to suppose. The usual proportion is about 30 tumours either starting in or secondarily affecting the ciliary body to 70 which affect the choroid only.

It has been previously pointed out how uncommon it is to find the angle of the anterior chamber free in cases of tumour affecting the choroid without the ciliary body, and consequently the majority of those in which this condition is present have increased tension. This was found to be so constantly the case that one was almost tempted to lay down the rule that if in an eye containing a growth the tension was found to be diminished, the growth had invaded the ciliary body.

There are, however, but few rules without exceptions, and having recently examined a case which proved an exception, I will here briefly relate it.

The patient was a man aged 56 who complained of failing sight in the left eye, which he had noticed for nine months.

On examination the tension was found to be slightly but distinctly lower than in the other eye; externally everything appeared normal.

On ophthalmoscopic examination, however, a detachment was seen towards the nasal side, and the whole appearance was suggestive of a tumour far forwards. The eye was excised and the following condition was found:

The cornea was healthy, the anterior chamber was rather deep and the angle by no means constricted, but was well open.

On section, the lens were found to be *in situ*, but the retina extensively detached, thus greatly diminishing the vitreous cavity; the detachment extended from the optic disc nearly up to the ora serrata.

Growing from the choroid and occupying about a half of the space beneath the detachment was a pigmented sarcoma of mottled appearance.

The center of its base was at the equator, and at no place did it reach the ciliary processes. Its measurements were 10 mm in height and the same across its widest part, its base measured 7 mm. There was the usual constriction seen about its middle, showing where the elastic lamina of the choroid had been perforated,

and this gave it rather the shape of a mushroom. The optic disc showed no cupping.

The idea that the increase of tension, which by some is always supposed to occur in cases of tumour of the eyeball, must evidently be abandoned, although it is possible that most of these cases, if left entirely to themselves, would at a late stage of their development exhibit glaucomatous signs.

But the point upon which I want to lay the greatest stress is this, viz., that the size of the tumour has practically nothing to do with the intraocular tension, at any rate not while the eye is still under the usual physical conditions of such an organ.

Of course if an eyeball is completely filled with a neoplasm the question of tension does not come in, for then all we can do is to palpate a more or less dense growth, while all the normal functions and physiological relations of the eye are destroyed.

It is a totally wrong impression which ascribes the tension to the fact that the globe has more inside it than it can comfortably accommodate. The vitreous contains so large an amount of fluid that it can by pressure be made to contain very much less, in this way resembling a sponge.

In conclusion, the necessity of carefully examining all forms of intraocular neoplasms must be urged. There are many points of doubt still to be cleared up, both as to the nature of ætiology and these malignant growths, and nothing but a careful and exhaustive enquiry into these matters is likely to advance our knowledge in this direction.

On Subhyaloid Hemorrhages. This is a pathological condition long recognized by ophthalmologists and one which has given rise to considerable discussion as to the exact situation which the blood occupies. It is a condition which, although easy enough to see clinically, yet its minute anatomy is but very imperfectly understood. This of course is due to the great difficulty there is of obtaining specimens for anatomical and microscopic observation.

Such eyes call for no special treatment, and certainly not for enucleation.

The ultimate result may be either the rupturing of the hyaloid membrane, in which case the blood may find its way into the vitreous direct, and after this has happened, such an eye is useless for the special purposes of our investigation, or else the blood becomes gradually absorbed and the eye recovers. The prognosis in these cases is by no means good, for as a rule the patient is suffering from more or

less extensive disease of the vascular system, which may prove fatal at any time.

A very perfect specimen illustrating the points under discussion was kindly brought me by Mr. J. B. Lawford, removed from a patient under his care at St. Thomas's Hospital, and after a thorough examination, both clinical and anatomical, a paper was written on the subject by Mr. J. Herbert Fisher, Assistant Ophthalmic Surgeon to St. Thomas's Hospital, and was published in the Ophthalmic Hospital Reports. Vol. xiv., Pt. ii.

The patient was a woman aged 60 years, who was first seen on April 30, 1895. She complained that the sight had been dim for ten weeks and that it had failed suddenly when engaged in laundry work. Shortly after this she was attacked with severe bleeding of the nose. A month after her first visit she again attended, when the hemorrhage was seen to have altered but little. On being told she could leave she attempted to rise from her chair, but had become paralysed on the right side. She was at once removed to the ward, where she died three days later. At the autopsy a large hemorrhage was seen to have taken place in the internal capsule. The right eye was removed and hardened in Formol 10 per cent, and after this it was divided equatorially. The hemorrhage was clearly visible, lying on or just within the internal limiting membrane of the retina. The whole posterior half of the eye was then imbedded in celloidin and sections were cut and stained in hæmatoxylin and eosin

The sections show the following condition:

On the vitreous surface of the extravasation there are two membranes running for the most part over the surface of the blood. That nearest the hemorrhage shows some nucleated cells in connection with it, while the other membrane is structureless in character. The first is the internal limiting membrane, while the second is the hyaloid membrane. They run for the most part parallel to each other, and both are on the surface of the extravasated blood; at one point, however, some red corpuscles are seen between the two membranes which are here slightly separated from each other; this shows the situation when the blood has burst through the internal limiting membrane of the retina but its further progress has been arrested by the hyaloid membrane; this condition is in the macular region. At the end of the section the blood has succeeded in passing through both membranes and is here spread out as a thin layer on the vitreous surface of the hyaloid membrane. The layers of the retina are not themselves infiltrated with blood, thus showing that it was easier for the blood to raise the internal limiting membrane than to find its way between the deeper layers of the retina

The source of the blood is certainly a retinal vessel, though it is impossible to form any clear idea as to which vessel gave way. Owing to the fact that the internal limiting membrane was stripped off for a considerable distance it may have been from a small artery, though there is nothing in the section to tell whether it is from an artery or a vein. We thus see that the cases of subhyaloid hemorrhage, or at

any rate this case (which was typical clinically) should be classed rather as a retinal hemorrhage, and there is but little doubt that this is a representative case of the disease.

Filamentary Keratitis is a disease which was but little known until recently.

It was first described by Leber in 1882, and the filaments were held by him to be of a fibrinous nature, which became twisted up with the peculiar threadlike processes which are attached at one end to the cornea and hang down on its surface with the other extremity free.

Fischer and Uhthoff[1] noticed that these cases at first developed small vesicles on the cornea, and these very soon burst and then from each of the small ulcers which resulted a small filament appeared. These authors agreed with Leber as to their fibrinous nature.

Carl Hess[2] and J. P. Nuel[3] have shown most conclusively that the small threads are composed, not of fibrin, but of epithelial cells, which have separated from the cornea and have assumed a spiral form.

With regard to the clinical history, we usually find that the disease occurs in old people, often without any recent injury, but frequently there has been some chronic conjunctivitis.

The following case is one which presents several points of interest and one which is very typical of the disease.

The patient was a man aged 66, who was admitted into the Royal London Ophthalmic Hospital, Moorfields, on Oct. 3, 1896, under the care of Mr. Lang, with the following history. The left eye had been blind for five years and the right for six months. Previous to this he had had excellent sight. The right eye had been inflamed and painful for ten days. The general condition of the patient was good, but twenty years ago a dog bit him and caused an ulcer on the leg, which is not yet well. Urine: Sp Gr. 1016: no albumen: no sugar.

The present state of his eyes are as follows:

Right eye: There is some ciliary injection and slight photophobia; attached to the cornea are numerous small filaments like threads, which hang down with a free lower extremity. The pupil is active. The lens forms a nearly complete cataract. Tension normal. V=Hand movement. Projection good.

Left eye: The Cornea and Iris are normal and there is no injection of the eye. The lens forms a hypermature cataract. Tension normal. V=P. L. Projection good. The left cataract was extracted and the eye did quite well and very good vision resulted.

With regard to the right eye a more detailed description of the cornea is needed.

On examination with the oblique illumination and a strong lens the surface is seen to be rough and uneven, and at the attached or upper end of each filament a

1. Bericht uber die versammlung der Ophthalmologischen Gesellschaft 1882 and 1889.
2. Archives für Augenheilkunde 1892 and 1893
3. Archives d'Ophtalmologie 1892.

small depression is seen. These little threads vary much in length and are of any size between about 0.5 mm and 4 mm.

They can be easily removed with a pair of forceps and scissors After removal they may be mounted fresh and examined microscopically or they may be first stained.

On Jan. 14, 1897, the right eye was operated upon for cataract and did quite well. In the following March the general health was good, R. V. = $\frac{6}{18}$ J. i. There was then no corneal affection.

At the present time (7 months after the right extraction) the vision of both eyes is $\frac{6}{12}$ and J. i. The cornea is quite healthy and there are no remains now visible of the late trouble

The condition has now been observed a sufficient number of times to make its nature certain, and I here give a photographic reproduction of one of the filaments.

Fig. I.

It is at once seen what a striking resemblance there is between this and the so-called Curschmann's spirals, which are so frequently found in the sputum of patients suffering from various forms of bronchial catarrh, and there is every reason for believing them to be the result of a proliferation and detachment of the corneal epithelium. What exactly causes the filaments to assume their somewhat peculiar shape is perhaps hardly known. Possibly the movements of the eyelids may have something to do with it, but, if so, it certainly must be something very different in the case of the filaments of bronchial origin.

The disease is sufficiently uncommon to justify me in recording such, but at the present time its ætiology is obscure. It is always associated with some corneal ulceration, and judging from the photophobia and other accompaniments of the disease it is very suggestive of its being of a neuropathic origin in connection with the fifth nerve and closely associated with herpes. When first seen the vesicles upon the cornea look very much like those which are so familiar in all forms of herpetic eruptions. In conclusion I wish to express my thanks to Mr. Lang for permission to publish this case.

Fig. II.
Diagram (high power) of a Filament, from J. P. Nuel.

CORRESPONDENCE.

CONCERNING THE COMBINATION OF CYLINDRICAL LENSES.

To The Editor of The Ophthalmic Record.

Sir:—In the August number of your journal appears an article entitled "The Combination of Cylindrical Lenses, and its Optical Effect, by David Kletsky." A perusal of this very surprising contribution would seem to indicate that its author was hardly prepared to undertake the discussion of the problem to which it relates. The results set forth are so utterly at variance with the truth, that were it not for the implied sanction which your publication has given them, their serious refutation would be unnecessary.

The solution of the "cylindrical problem," although not particularly difficult, is hardly as simple as the author of this paper seems to

imagine, and if he had taken the trouble to attempt the practical verification of his tables, their inaccuracy would have been immediately evident. It is true that the problem is not discussed in many text books on the eye. Its practical importance is not such as to warrant its presentation to beginners.

The combination of a plano-concave and a plano-convex cylindrical lens with equal and opposite rotation about a common axis, the angle included between the axes of their refractive surfaces varying from 0° to 90°, has been familiar for at least thirty-five years under the name of' 'the astigmatic lens of Stokes.'' The solution of the general problem relating to the refractive value of any two combined cylindrical surfaces is given by Donders, and has since been performed by other writers.*

This solution may be expressed in the following equations:

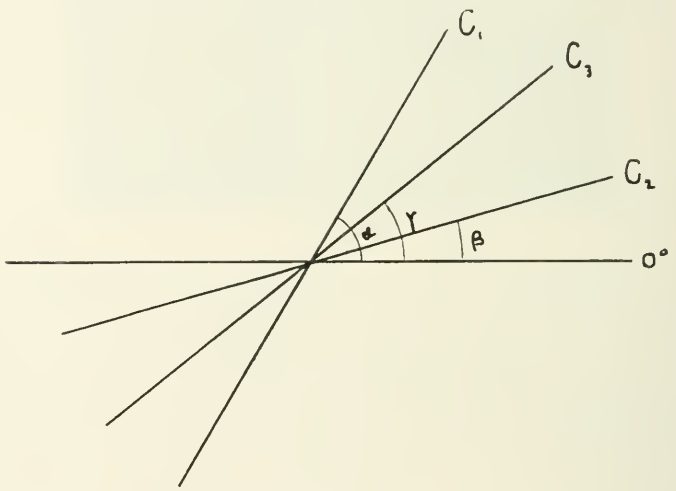

Fig. 1.

$$\tan 2\gamma = \frac{C_1 \sin 2\alpha + C_2 \sin 2\beta}{C_1 \cos 2\alpha + C_2 \cos 2\beta} \qquad \text{(I.)}$$

$$C_3 = \frac{C_1 \sin 2\alpha + C_2 \sin 2\beta}{\sin 2\gamma} \qquad \text{(II.)}$$

$$D = \frac{C_1 + C_2 - C_3}{2} \qquad \text{(III.)}$$

*Donders: On the Anomalies of Refraction and Accommodation, 1864. p. 499-500.
Jackson: Trans Amer. Oph. Soc 1886. Hay: *ibid.*
Weiland: On the Refractive Value of Any Two Cylinders etc. Arch. of Oph. Vol. XXII. 1893. p. 435
Also by Hoorweg, Oliver, Heath and others.

C_1 is the dioptric value of the first cylinder which makes an angle α with the meridian O^0.

C_2 is the dioptric value of the second cylinder, which makes an angle β with the meridian O^0.

C_3 is the dioptric value of the resulting cylinder, making an angle γ with the meridian O^0.

D is the dioptric value of the spherical lens which added to the value of C_3 gives the sphero-cylindrical equivalent of the combination.

Applying these formulae to the "Stokes lens," and assuming that the meridian O^0 bisects the angle included between the axes of the cylinders.

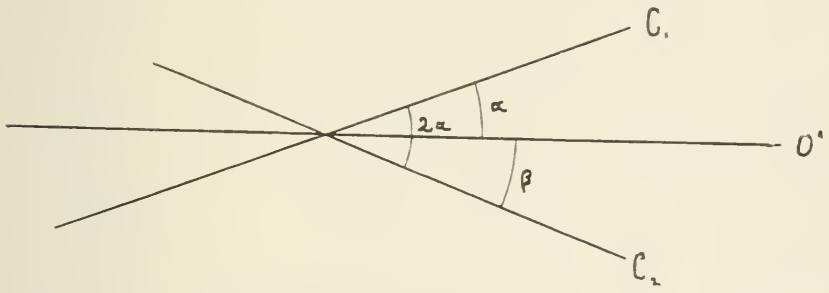

Fig. 2.

Angle α = — angle β, whence sin 2β = — sin 2α. $C_1 = -C_2$.

Substituting these values in (I) we have,

$$\tan 2\gamma = \frac{2\,C_1 \sin 2\alpha}{O} = \infty$$

Therefore $2\gamma = 90°$. and

$\gamma = 45°$. (A)

Substituting the above in (II) we have

$C_3 = 2\,C_1 \sin 2\alpha$ (B)

where 2α is the angle included between the axes of the cylinders.

$$D = \pm \frac{C_3}{2} \qquad (C)$$

Now from (A), (B) and (C), the sphero-cylindrical equivalent of the Stokes lens may readily be calculated for any assumed values of C_1, C_2 and 2α

Thus, assuming C_1 = + 2.25 D. C_2 = — 2.25 D. the following table may be constructed:

Angle between axes = 2 α	Equivalent crossed-cylinders.	Equivalent spherocylinder.
10°	—0.39 ax 135°⌒+0.39 ax 45°	—0.39⌒+0.78 ax 45°
20°	—0.76 ax 135°⌒+ 0.76 ax 45°	—0.76⌒+1.53 ax 45°
30°	—1.12 ax 135°⌒+1.12 ax 45°	—1.12⌒+2.25 ax 45°
40°	—1.44 ax 135°⌒+1.44 ax 45°	—1.44⌒+2.89 ax 45°
50°	—1.72 ax 135°⌒+1.72 ax 45°	—1.72⌒+3.45 ax 45°
60°	—1.95 ax 135°⌒+1.95 ax 45°	—1.95⌒+3.90 ax 45°
70°	—2.14 ax 135°⌒+2.14 ax 45°	—2.14⌒+4.28 ax 45°
80°	—2.21 ax 135°⌒+2.21 ax 45°	—2.21⌒+4.43 ax 45°
90°	—2.25 ax 135°⌒+2.25 ax 45°	—2.25⌒+4.50 ax 45°

Now if the cylinders are equal in refractive power and are both convex, assuming $C_1 = C_2$, $\alpha = 90° - x$, $\beta = 90° + x$, (Fig. 3.)

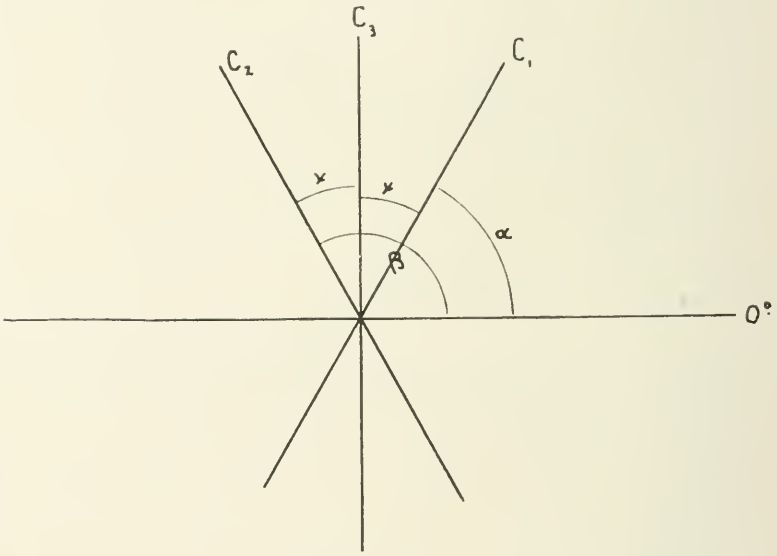

Fig 3.

Substituting these values in (I), we have

$$\tan 2\gamma \quad 0$$

$$\gamma = 90° \qquad (a)$$

In obtaining the value of C_3, if we use the equation

$$C_3 = \frac{C_1 \sin 2\alpha + C_2 \sin 2\beta}{\sin 2\gamma} \qquad \text{(II)}.$$

its value becomes $\frac{0}{0}$, and is therefore indeterminate, substituting then the above values in

$$C_3 = \frac{C_1 \cos 2\alpha + C_2 \cos 2\beta}{\cos 2\gamma} \qquad \text{(VI).}$$

γ 0, $\cos 2\gamma = 1$, $\cos 2\alpha = \cos 2\beta$

$$C_3 = 2\,C_1 \cos 2\alpha \qquad (b)$$

$$D = \frac{C_1 + C_2 - C_3}{2} = \frac{2\,C_1 - C_3}{2} \qquad (c)$$

From these equations, (a), (b) and (c) we may construct the following table:

When $C_1 = C_2 = +1.50$ D. and $\gamma = 90°$, $\alpha = 90° - \gamma$. $\beta = 90° + \gamma$.

Angle α.	Equivalent sphero-cylinder.
90°	+ 0.00 ⊃ + 3.00 ax 90°
85°	+ 0.02 ⊃ + 2.95 ax 90°
80°	+ 0.09 ⊃ + 2.82 ax 90°
75°	+ 0.20 ⊃ + 2.60 ax 90°
70°	+ 0.35 ⊃ + 2.30 ax 90°
65°	+ 0.50 ⊃ + 1.99 ax 90°
60°	+ 0.75 ⊃ + 1.50 ax 90°
55°	+ 0.98 ⊃ + 1.03 ax 90°
50°	+ 1.24 ⊃ + 0.52 ax 90°
45°	+ 3.00 ⊃ + 0.00 ax 90°

Other tables can be similarly constructed. I have given these because the values of C_1, C_2, α and β are those taken by Dr. Kletzky in the article referred to.

Very respectfully yours,

HAROLD WILSON, M. D.

32 West Adams ave., Detroit Mich. August 23, 1897.

REVIEWS.

What Are the Functions of the Rods and Cones and the Pigment Epithelium Layer of the Human Retina? By Frank P. Pratt, M. D., in The Medical Record, Aug. 28th, 1897. The generally accepted theory is that both the rods and cones are the terminal cells of the optic nerve; that the image of external objects is focused upon this layer, and that here light vibrations are changed into another kind of motion, namely, nerve stimuli; that certain mechanical and perhaps chemical changes take place in the epithelial pigment layer, and that a peculiarly intimate relation exists between this layer and the layer of rods and cones.

Fuchs says that the place in which the conversion of luminous vibrations into nerve exitation occurs is the rods and cones. I wish to present the following hypotheses:

1st. That the cones alone are the terminal cells of the optic fibres in the human retina.

2nd. That the rods are supporting tissues to the cones, their outer segments practically forming a part of the pigment epithelial layer.

3rd. That the tenth or pigment layer is that in which light vibrations are changed into nerve stimuli.

A full consideration of the microscopical anatomy of the retina would be impossible here, on account of the limited space; reference, therefore, must be made to the text books of anatomy and histology. Piersol's article on "Microscopical Anatomy of the Retina," and May's on "Photo-Chemistry of the Retina," in Norris and Oliver's work, cover the field very fully.

Assuming then, that this histological knowledge is in mind, we will review only such salient points as are necessary to make clear the foundation for the propositions above presented.

The retina of the old school comprised the nine innermost layers only, or that part which includes the fibres and terminal cells of the optic nerve, together with the internal limiting membrane. Later research has demonstrated that the epithelial pigment layer also belongs to the retina, and constitutes its tenth stratum. This layer is in intimate relation with the ninth, and, together with the seventh and eighth layers, has no blood vessels of its own, but receives its nourishment from the same source—the choroidal vessels. The rods

and cones alike pass through the cribriform external limiting membrane, the rods extending to the "base" of the epithelial cells, where they terminate in irregular "gnawed off" ends; the epithelial cells sending down protoplasmic processes between the rods and cones to various depths; or this epithelial "base" may be considered as a "disc," which is perforated with cylindrical channels for the reception of the external segments of the rods. Thus the outer rod cell is plunged deeply in the pigmented portion of the epithelial cells. This relation of rods and epithelial processes is maintained uninfluenced by the light stimulus. The cones also pass outward and terminate in gently rounding ends, which reach little more than half-way to the "base" of the epithelial cell. The cone is not a fixed cell, but under the influence of its normal stimulus retracts, so that the whole cell is nearer the external limiting membrane. When this stimulus is removed the whole cell again advances. This is an important difference, and should be given its proper weight in a consideration of the functions of the rods and cones. Authorities differ as to whether the terminal cell is connected to the nerve fibre by continuity, or simply by continuity or approximation. Hosch, however, claims that he "finds in the Golgi silver preparations evidence of direct anatomical continuity between the fibrils proceeding from the base of the cone cell and the processes of the nerve cell." No such continuity has been demonstrated or claimed for the rod. What proofs, then, have we that the cones alone are the terminal cells of the optic nerve in the human retina? Consider in this light the following facts: 1st. That the cones alone have been demonstrated to be connected directly with the filaments of the optic nerve. 2nd. That no such claim is made for the rod; in fact the base of the rod is known to terminate in a bulb, and approximation is its only relation to the nerve filaments. 3rd. That the cone is mechanically irritated by converted light stimulus, as shown by its power of contraction and extension under that stimulus. 4th. That converted light stimulus has no mechanical effect upon the rod; that its close relation to the base of the epithelial cell remains unchanged under its influence. 5th. That the only change noted in the rod cell is that which occurs in the bleaching and reproduction of the so-called visual purple, which has its exclusive seat in the outer segment of the rod cell, and this bleaching appears to be effected by the action of the luminous vibrations themselves, and not by the proper nerve stimulus. Light vibrations as such are not excitors to the terminal cells of the optic nerve. 6th. That the cones alone

occupy the the position of most acute vision. 7th. That the rods are not necessary to acute and perfect vision. 8th. Because in central scotoma the disease involves only that portion of the retina which has to do with acute vision, namely, the macular region; yet a cross-section of the optic nerve, where it enters the bulb, shows an accompanying atrophy of nerve filaments, which occupy a sector-shaped space, with base out and apex towards the center, and make up nearly or quite one-third of the total nerve filaments (Fuchs).

When we consider what a small part of the retinal surface the macular region occupies and how insignificant numerically the cones of this region are compared with the combined rods and cones of the extra-macular region, it not only adds weight to the belief that each cone in this region has an individual nerve fibre, but also to the fact that each cell element of the extra-macular region cannot have an individual nerve fibre, nor one fibre for seven cells, as estimated by Selzer and Krause. These authorities estimate the cones at 7,000,000. Becker estimates 13,000 in the macula lutea. The rods are much more numerous, being estimated as high as 130,000,000 by Krause. Selzer and Krause estimate the number of measurable fibres of the optic nerve at 425,000. Now taking out the 13,000 fibres distributed to the macular cells, there remain 412,000 fibres to be distributed to 137,000,000 extra-macular cells. If these were distributed to both the rods and cones there would be 1 fibre to 332 cell elements; if to the rods alone, 1 to 301; if to the cones alone, 1 to about 17. These estimates furnish additional evidence that the cone cells alone receive filaments of the nerve.

9th. That the normal position of the cone is at right angles to the external limiting membrane and the pigment epithelial layer. That this position can be thus maintained, outside of the macular region, only by appropriate supporting tissue.

In the macular region each cone is a support to its neighbor, therefore no rods are necessary. In the extra-macular region the cones become farther and farther apart towards the peripheral portions of the retina; they can no longer support each other, therefore rods appear, and with the protoplasmic processes of the epithelial layer and the modified lymph, fill in the intervening spaces. The rods, which in the macular region form a single layer around each cone, gradually increase in number, until, in the region of the ora serrata, each cone is surrounded by three or more layers of rods. The outer segment of the supporting rod, as it dips deeply into the pigment processes of the epithelial layer, thus becomes practically a part of that layer.

10th. That in proportion as the cones increase in number over a given area, vision increases and vice versa. Thus the cones within the macula lutea are many times more numerous than in any other equal space on the retina. Therefore, more terminal filaments being irritated, sight is more acute.

The third general proposition is that the tenth retinal layer is that in which light vibrations are changed into nerve stimuli.

Briefly stated, the tenth layer is composed of a single stratum of hexagonal cells, a view of the inner surface of which shows a beautiful mosaic arrangement, deeply pigmented, except in the region of the nucleus. A vertical section shows the cell to be divided into three parts or zones—the outermost containing the nucleus, and being unpigmented, a middle zone deeply pigmented, sometimes known as the "base" of the cell, and an irregular zone of "indefinite protoplasmic processes," extending between the outer segments of the rods and cones. This pigment is special and peculiar to this layer; it differs from the stroma pigment of the choroid in being crystaline and rod-shaped instead of granular. Under the influence of light these pigment crystals advance within the protoplasmic extensions of the "base" of the cell, between the rods, the migration not being accompanied by the protraction and retraction of the processes themselves.

I present the following reasons for believing the third general proposition to be true: 1st. The pigment epithelial cells increase in size from the region of the fovea, where they are the smallest, to the region of the ora serrata, where they reach the maximum size, thus coinciding with the decreasing number of cones from center to circumference, so that it is probable that when the ninth and tenth layers are in their normal position each cone points to the center or nucleus of each epithelial cell. 2nd. The peculiar yet significant associated action of the epithelial pigment and the cone cell, under the influence of light stimulus, as the pigment advances within the epithelial processes, the cone retracts, and vice versa, their relative positions being little changed. 3rd. The position of the cone is strong evidence that the image is not formed upon this layer. Nature is a conservator of forces; then why does she not turn the cones towards the source of light, if the layer is the necessary surface upon which the image is cast, instead of turning them in the opposite direction? In the one position the image would fall directly upon the percipient surface; in the other the light rays pass through the nine different rétinal layers to accomplish the same purpose, if the accepted theory is true.

Nature has made no mistake. The cones are turned towards the source of their normal stimuli, but this stimulus is not light vibration, as such, and therefore does not come from the object itself; it is another form of energy. "This is, without a doubt, simply another sort of motion, of such a nature as to be transmitted within the nerve fibres to the brain—a property which is not possessed by th evibrations of luminous ether" (Fuchs). Thus it would seem that "vibrations of luminous ether" must pass unobstructed through the various retinal layers, including the cones, until they are focussed upon the tenth layer, which point is a murky "veil" at the focal point of the normal eye, fixed between the delicate terminal cells of the optic nerve and the choroidal coat. It is the ground-glass plate of our living camera, upon which the images in our visual field are spread in all their various colors, and in which, in a manner not yet fully understood, light vibrations are transferred into nerve stimuli, and from which comes the normal stimulus of the ocular fibres. It is well known that the anatomical and histological arrangements of tissues are not the same in different vertebrates—thus, in the frog rods may predominate in the region of the most acute vision, or that rods alone, or perhaps modified cones, may alone be present in others, or that a complete decussation of the optic nerve fibres takes place in some of the lower animals. Yet this does not warrant us in assuming that the above facts do not hold true in man. In the words of Fuchs, in speaking of the decussation of ocular fibres: "The only mistake that has been made in assuming the same condition to hold good for the higher vertebrates also."

It is not claimed here that pigment is necessarily present in order that this change from light vibrations to nerve stimuli may take place, for in albinos, in which pigment is absent, the visual act is accomplished, yet always imperfectly. It is, therefore, probable that in exceptional cases some modification in the pigment substance takes place, yet always at the expense of perfect vision.

Much has been said about the visual purple or rhodopsin of Boll. Yet when all is said, little or nothing is known of its real utility. We know that it exists exclusively in the outer segment of the rod, that even in the cone cell of the extra-macular region it is not present. That it is not essential to perfect vision is evidenced by the fact that it is absent in the region of the fovea. "Animals that have been deprived of visible purple do not act differently from those which possess it. Frogs without this visible purple search for their favorite color, green" (May). In fact, it may act, owing to its position, in common with the elements of the pigment layer in absorbing and transforming luminous ether vibrations into normal nerve stimulus.

E. OLIVER BELT.

REPORTS OF SOCIETIES.

CHICAGO OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY.

A regular meeting was held October 12th, 1897, Dr. Montgomery in the chair.

Dr. W. H. Wilder showed a man of 50, with a good family and personal history, whose mother had suddenly become blind after suffering severe pain. In August, 1896, the patient noticed that vision in the left eye became very poor, and blood was seen at that time in the anterior chamber. There was no pain then, but it developed soon afterwards. There was detachment of the retina, which is now complete. He consulted a number of oculists, some of whom called it an iritis, and others glaucoma. Six months ago an iridectomy was done upwards, and following the operation there was considerable pain and hemorrhage. At present the tension of the eye is slightly increased and there is slight pain. There is a large amount of fluid blood in the anterior chamber, which has been there for a long period. The lens is cataractous. About a week ago well marked pain suddenly developed, and three days later there was found on the cornea three small vesicles overlapping each other like the three links of a chain, probably a true herpes.

Dr. Hotz thought the case was hardly one of hemorrhagic glaucoma because of the great depth of the anterior chamber and of the slight, if any, increased tension. He had always found the chamber very shallow in cases of hemorrhagic glaucoma.

Dr. Montgomery had seen a case six months ago in which the tension was + 3; but there was no hemorrhage. The anterior chamber was deep. A tumor was suspected, and an iridectomy was made, following which the tension dropped to normal, and there was perception of light. Recently, however, the tension had again gone up and hemorrhages had appeared in the anterior chamber.

Dr. Colburn had seen cases in which there was retinal hemorrhages, followed later by blood in the anterior chamber. In regard to the vesicles in this case he had seen several, but none where they were arranged in this way. He had noticed in some cases of choroiditis that vesicles appeared at times, usually accompanied by great pain.

Dr. Montgomery had seen cases of complete detachment develop pain from glaucoma, or from uveitis.

Dr. Gradle had found uveitis not uncommon in detachment cases, but had never seen glaucoma following.

Dr. Hotz had never seen glaucoma follow detachment of the retina.

Dr. Oscar Dodd showed the case of an ulcer on the palpebral conjunctiva, which was first seen three weeks ago, at which time there was no swelling. The ulcer was small, and the discomfort had existed about a month. It slowly extended and soon involved the whole surface including the edge of the lid. The lid is now considerably swollen. Nitrate of silver and other antiseptics had no effect on the ulcer, and although a history of syphilis was denied, it is probably a chancre.

Drs. Montgomery, Hotz and Pinckard had all seen cases of chancre of the conjunctiva following the removal of the foreign body by means of the tongue

Dr. Henry W. Woodruff of Joliet, showed a boy who was struck on the left eye on the fourth of July. He was first seen a month later, at which time there was a cataract and a small cyst in the upper outer periphery of the iris, very well defined, and occupying about a third of the breadth of the iris.

He referred to another case he had recently seen in a man 55 years old with good vision, whose pupil dilates well except at the point of the cyst. As far as could be determined this was a congenital condition.

Dr. Dodd had studied two cases of cyst of the iris with Treacher Collins of London, both of which were traumatic. Such cysts are supposed to develop by some from the crypts in the iris; by others from a hemorrhage in the periphery, which later develops into a cyst.

Dr. Gamble showed a case of locomotor ataxia in a girl of eight years, first seen May 17th, 1897. Vision in the right eye, fingers at three feet, and left eye p. l. Ophthalmoscopic examination showed primary gray atrophy of both discs with marked atrophic cupping. Pupils dilated; no reflex to accommodation or light. Patellar reflexes gone; Romberg's symptom much pronounced. No nystagmus. She never had any severe illness except diphtheria when one year old, which was not followed by sequelae. She had severe headaches from infancy at irregular intervals, vary from one month to six months. During one of these attacks her hand became so numb that she could not feel the doorknob and open the door. No cerebral disturbance

noticeable; no girdle symptoms. Was examined by Dr. King, who found no change in sensation.

The father was examined in the latter part of May and found to have primary gray atrophy of the discs. He had had a chancre in 1871. He was also examined by Dr. King, who made a diagnosis of locomoter ataxia.

Dr. Gamble showed a case of sarcoma of the ciliary body involving also about one-third of the iris. As far as could be determined, this had existed only a few months.

Dr. Wilder showed a case of dermoid tumor of the cornea.

Dr. Hotz had seen several true cysts of a dermoid character occurring on the cornea.

Dr. Hotz read a report on Holocain. This paper will appear in December number of the OPHTHALMIC RECORD.

Dr. Hale said it is reported that holocain is in itself an antiseptic and will keep indefinitely.

Dr. Pinckard referred to the new form of eucain called eucain B, and had found it very satisfactory in his experience, there being little or no pain attending its application. It will keep indefinitely and will stand boiling without changing its character.

C. P. PINCKARD, M. D.
Secretary.

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EDITORIALS.

HOSPITAL ABUSE.

"The County of New York has at the present time 26 hospitals and 114 dispensaries. During 1895 in the former 75,386 patients were treated free and in the latter 661,803 making a total of 737,171. The population of the city is 1, 851,060 so that the proportion of such free patients to the whole community is thirty nine per cent. Dr. Landon Carter Gray made the preceeding statement during an address delivered before the New York County Medical Society last September. The total number of patients treated by physicians without pay throughout the United States must be something enormous if Dr. Gray's figures are to be taken as representing a true state of affairs. To anyone who is at all familiar with even a few of the many papers which have lately appeared in our medical journals discussing a subject which has been very well termed "The Abuse of Medical Charity" there can be not the slightest doubt that a considerable proportion of the population apply for and receive medical treatment although they have the ability to pay for the same. The hospital and dispensary should be considered simply as a place where the sick can receive the necessary treatment that they are unable to obtain in any other way, but the policies of the administrations have gradually yielded to the tendencies of the times so that now many of our large institutions are so easily accessible and so admirably arranged that they permit the handling of large numbers of patients with remarkable celerity. As a justification of the Stewardship the reports are expected to show an increase in attendance year by year. The physician on account of the limited time at his command is powerless to eliminate, except in rare

instances, those who have come to be known as "Unfits." It is therefore not surprising that under the circumstances a large and constantly increasing class in the community should come to finally regard the advice so easily obtained as theirs for the asking. The governing boards of institutions should realize the injustice that is being worked upon the profession at large, the younger members in particular, and endeavor in some way to bring about a mitigation of the evil. The length of an illness, the character of an injury, or the loss of time involved largely affects the question as to what constitutes an abuse of medical charity; for while the care and attention requisite in managing a case of typhoid fever might be beyond the financial possibilities of an individual, the same person might be perfectly able and willing to pay a moderate fee for the relief of some slight ailment, as for example the correction of an error of refraction. In this connection it might be well to emphasize the importance of concerted action on the part of ophthalmologists with view of restraining this desire of the public to avoid a just obligation, for the wide spread knowledge of the nature of the work done at an eye hospital, the attractive appearance of the surroundings together with the ease and precision with which the examinations are carried out, both inspires confidence in the patient and likewise arouses a feeling that treatment obtained at such a place is especially to be desired; and it is not to be wondered at that the daily attendance should be composed of so many who as they readily admit come "because it is the best place." This class which includes no small part of the "Unfits" is usually perfectly reasonable when explanations are given as is also the class which believes that the "Hospital Doctor" occupies a salaried position and therefore does himself no harm by treating without pay, those who are able to remunerate him. The unpleasant patients however are those who have applied for treatment knowing their own ineligibility, and who intend to resort to subterfuge to gain the desired end. Although a few words will set the well intentioned right one of the latter class frequently become argumentative and at times even abusive which would naturally if necessary carried out by a properly constituted executive officer suggest that some place more suitable than a clinic room be used for this purpose. When deceit is so openly practiced to attain the end in question a rigorous method of interrogation should be resorted to and delegated for the position and responsible to the hospital management and not to the staff of physicians. By this arrangement will the staff be relieved of the imputation of cupidity and the managers better fulfil

the conditions of the various trusts imposed upon them by the benefactors of the institutions. How often are we reminded that our professional training is our "stock in trade" and that the money therein invested should make returns in the nature of an adequate professional income but how little real influence does this have in affecting the professional behavior of the physician in the practice of his profession. The legal profession provide no such conveniences for the gratuitous dispensing of advice, indeed their system is so well arranged as to even prevent competition from unworthy sources of information. The manufacturer would be rather amused than otherwise were it suggested to him that he devote two hours each day in relieving the worthy poor by donations from his stock room and I doubt if the capitalist would be willing to relieve present necessities by loans of money on undoubted security without interest. The feelings of the writer are of the kindliest towards the unfortunate and he is also most heartily in accord with those who are endeavoring to render the burden they carry less heavy but he wishes to join with others in an indignant protest against the too frequent examples of indiscriminate charity of which many of us are so familiar.

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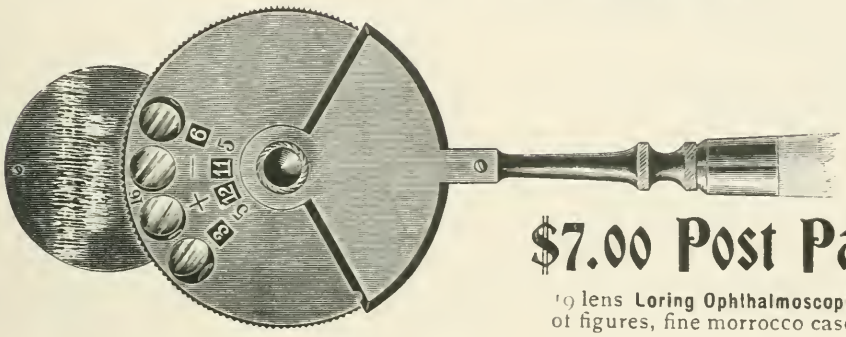

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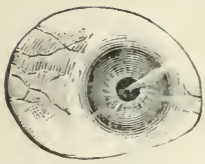

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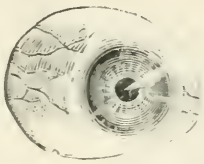

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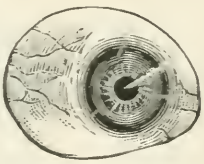

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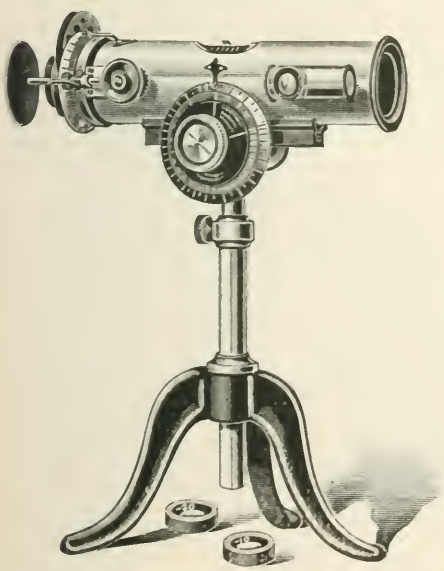

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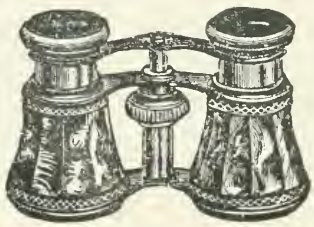

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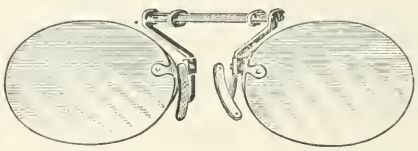

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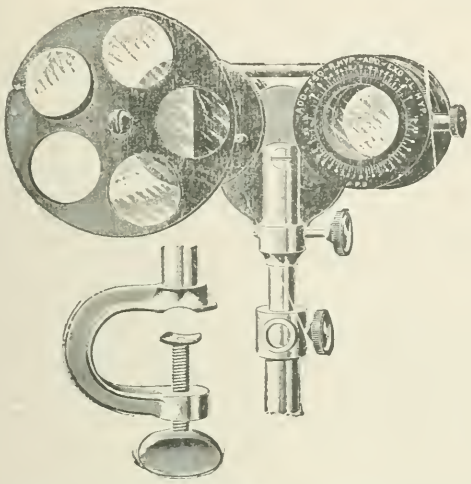

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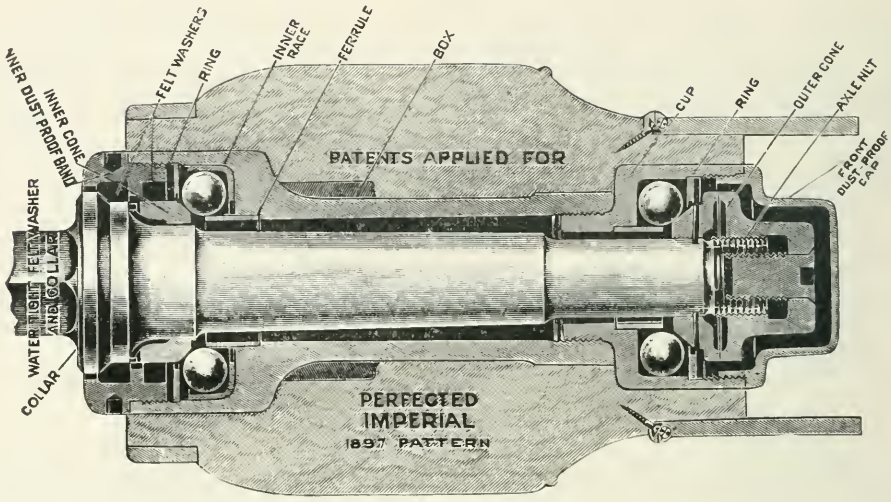

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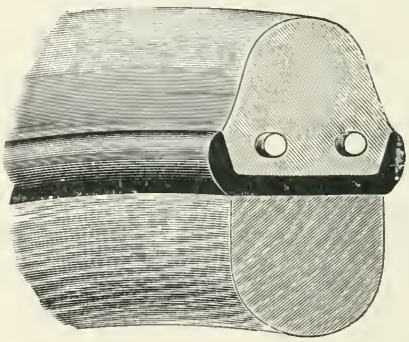

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